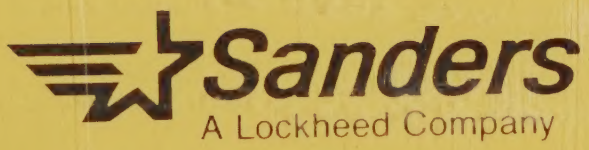
H-81-0323
REV A

Operation
and
Maintenance Instructions

MODEL 5440C
NOISE FIGURE TEST SET



ELECTRONIC COMPONENTS
BUSINESS DIVISION
MANCHESTER, NH 03103

3 OCTOBER 1983

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Operation and Maintenance Instructions

MODEL 5440C NOISE FIGURE TEST SET

Sanders
A Lockheed Company

ELECTRONIC COMPONENTS
BUSINESS DIVISION
MANCHESTER, NH 03103

3 OCTOBER 1983

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

Model 5440C Noise Figure Test Set, hereinafter called the test set, is a small, rugged, lightweight unit capable of making fast, reliable noise figure measurements. The test set has a continuously variable IF input frequency range with expanded range options. The test set is capable of checking receiving systems performance, evaluating preamplifiers and traveling wave tubes (TWT's), rapid verification of large ECM and communication receiving systems, and online performance monitoring.

1.1.1 SCOPE OF MANUAL. This manual contains general information; theory of operation; installation, operation, and maintenance instructions; and parts lists for Model 5440C Noise Figure Test Set. This manual is intended for use by personnel responsible for operating or maintaining the test set.

1.1.2 PURPOSE AND FUNCTION. Model 5440C Noise Figure Test Set (shown in figure 1-1) is a portable instrument capable of evaluating receiving systems in the 10 kHz-to-40 GHz range. Typical measurement accuracy is ±0.5 dB, excluding the noise source variation across the band. Table 1-1 lists the Model 5440C Noise Figure Test Set specifications.

The test set operates from spurious-free IF signals of 10 to 200 MHz without the need for preselection (if the image band is

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Figure 1-1. Noise Figure Test Set Model 5440C

suppressed). A continuously-variable preselector is built into the test set that limits the noise figure measurement to an approximately 1-MHz bandwidth centered at the selected IF frequency. The IF input is under AGC control and has a sensitivity of -50 dBm. Options are available providing increased IF input sensitivity to -80 dBm (see table 1-5).

Four light emitting diode (LED) indicators are provided as operator aids. Two of the indicators alert the user if the IF or video output of the system under test is too high or too low. An appropriate correction of the system's gain control is made until both HI and LO indicators go out. The other two LED indicators identify when the operator is injecting too much or too little excess noise into the system under test. A reasonable amount of excess noise must be used for a given system because of the wide measuring range of the test set (2 dB to 32 dB).

Another feature of Model 5440C Noise Figure Test Set is the 5 MHz-to-18 GHz noise source (a 1-inch cylinder, 3 inches long) that can be located up to 300 feet from the test set. In many installations, this permits the entire system, including the antenna lines, preamps, TWT's, couplers, rotary joints, and their interconnecting lines to be included in the noise figure measurements. A defective component in the front end chain can be isolated quickly by connecting the noise source before or after a suspect unit or cable.

If desired, the noise source can be permanently installed in a system by using coaxial switches and/or directional couplers. Up to five noise sources may be operated simultaneously at remote locations.

Table 1-1 Specifications

RF MEASURING RANGE	5 MHZ to 18 GHz (options to 40 GHz and 10 kHz available); see table 1-5.
NOISE SOURCE EXCESS NOISE	25.5 ± 0.75 dB from 5 MHz to 18 GHz
OUTPUT IMPEDANCE	50 ohms nominal
INPUT POWER	+22V, 15 mA maximum (+28V for option)
NOISE FIGURE MEASURING RANGE	2 dB to 32 dB
ACCURACY (EXCLUDING NOISE SOURCE AND ATTENUATOR ACCURACY)	±0.5 dB ±5% of indicated reading. (Excess noise = noise figure ±5 dB.)
INPUT REQUIREMENTS:	
Video	Band-limited noise, representative of the envelope of the IF signal to within ±1 dB over a 12-dB minimum dynamic range with an RMS voltage adjustable to 100 mV minimum and with frequency components higher than 3 kHz.

Table 1-1 Specifications (Cont)

IF	10 MHz to 200 MHz with continuously-variable built-in preselector
Input level	-50 dBm minimum (noise source off); options to -80 dBm (see table 1-5) -10 dBm maximum (noise source on)
AGC RANGE	40 dB nominal
X-Y RECORDER OUTPUT	Scale: 0.1 V/dB noise figure Maximum load: 2000 ohms
RECORDER CALIBRATION	3V reference represents 30 dB noise figure
OPERATOR INDICATORS	INPUT LEVEL HI INPUT LEVEL LO EXCESS NOISE HI EXCESS NOISE LO NOISE FIGURE
INPUT POWER REQUIREMENTS	115/230 Vac ±15%, internally selectable. 50 to 400 Hz. Less than 20 watts.

Table 1-1 Specifications (Cont)

SIZE AND WEIGHT	Height 12.7 cm (5 inches) Width 17.8 cm (7 inches) Depth 19.3 cm (7.6 inches) Depth with cover 29.5 cm (11.6 inches) Weight 3.64 kg (8 lbs)

Noise figure is displayed to the nearest tenth of a decibel on the digital panel meter of the test set as the system under test is tuned across its RF band. An analog voltage output linearly proportional to the measured noise figure is also provided; the scale is 0.1 V/dB noise figure. This output can be used to drive an X-Y plotter or other hard copy device to generate permanent records of the noise figure measurements. When X-Y plots are generated using the test set, the time required for each plot is typically less than two minutes.

The dc tuning voltage of the system under test is applied to the X-axis input of the plotter, while the test set analog voltage is applied to the Y-axis. However, a general purpose analog meter may also be used in place of the X-Y recorder if the operator prefers.

A permanent record can be maintained to observe degradation in individual receiver performance. These records can be used to determine which receivers should be pulled for maintenance and which ones are within acceptable performance limits.

1.1.2.1 Noise Figure Definition. The sensitivity of a receiving system is determined by the noise presented to the system along with the signal. In a microwave receiver this noise is generated by the input termination, usually an antenna, and has an available noise power at the receiver input of Pn = KTB where:

Pn = Input noise

K = Boltzman's constant, 1374×10^{-23} Joule/degree K

T = absolute temperature, degrees K

B = bandwidth, Hz

Any detection system adds additional noise, which is generated by the amplification process. This added noise is usually larger than the input termination noise. If a receiving system were perfect (that is, no noise added during the amplification process), the output noise power would be KTBG, where G is the power gain of the system. A figure of merit for an actual receiver is the ratio of actual output noise power (when T = 290°K) to the theoretical minimum. This figure of merit is noise figure (NF) referred to room temperature (T = 290°K). The noise figure computations are depicted in the following formula where N_1 is the noise power output of the system under test measured when To = 290°K.

$$NF = \frac{N_1}{K\,TO\,BG}$$

A perfect system would have a noise figure of 1 (0 dB).

The complete equation derivation is not presented here. The final equation has the form

$$NF = N_{EX} - 10 \log (N_2/N_1 - 1)$$ where,

N_{EX} = Excess noise power from the noise source

N_2 = System noise power output with noise source on.

N_1 = System noise power output with noise source off.

1.1.2.2 Tangential Sensitivity. The tangential sensitivity of a receiver is considered to be eight dB above noise level. The conversion chart in figure 1-2 can be used to determine tangential sensitivity when the noise figure and the noise bandwidth of a receiver under test are known. For example, a receiver with a noise figure of 15 dB and a noise bandwidth of 1 MHz would have a tangential sensitivity of approximately -91 dBm.

NOTE

If a receiver's noise bandwidth and tangential sensitivity are known, the anticipated noise figure can be obtained from the conversion chart and used to select N_{EX} and attenuator values from table 2-1 or to verify the results of the test set.

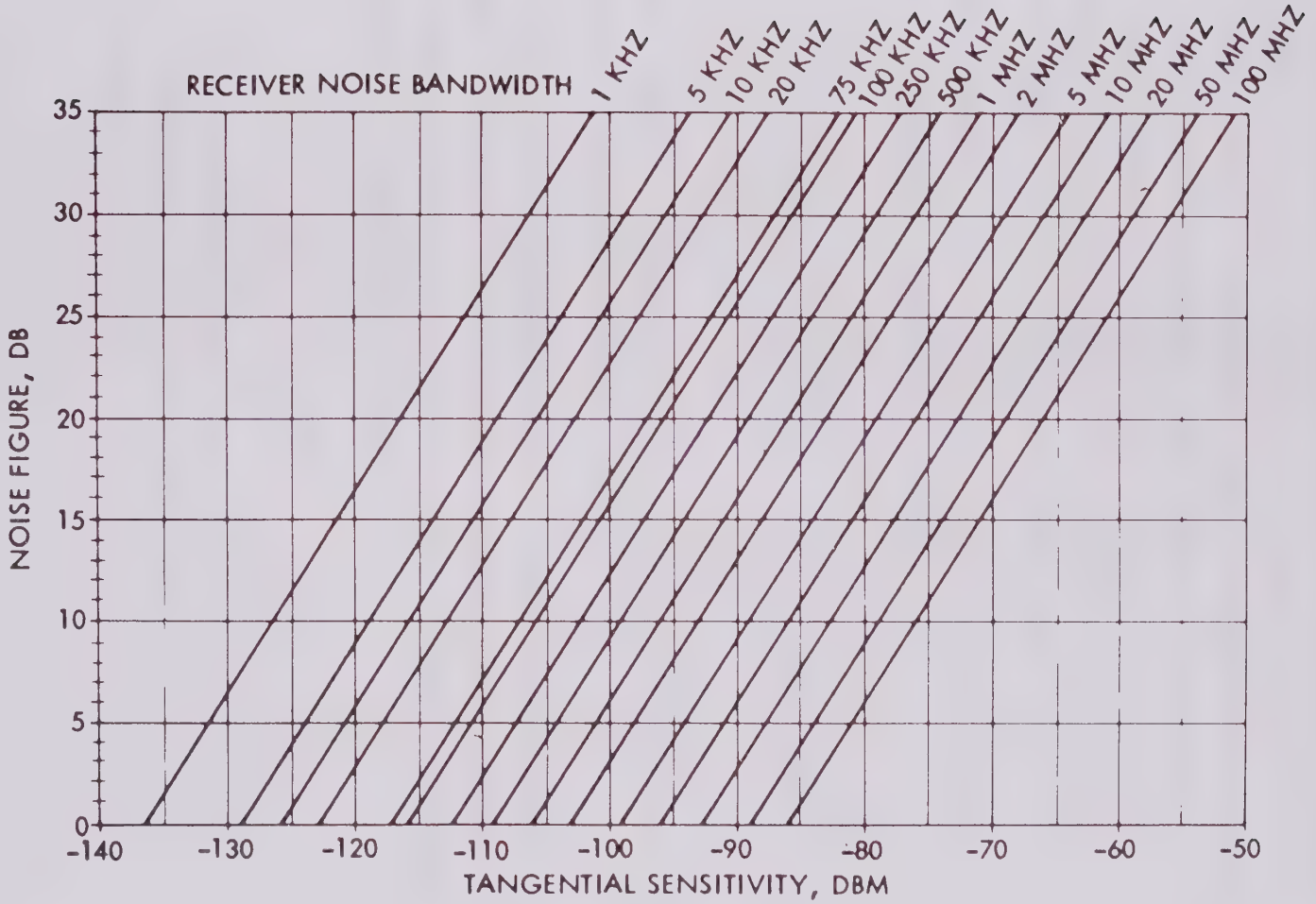


Figure 1-2. Conversion Chart

1.1.2.3 Power Requirements. The test set operates on either a 95-to-125 Vac or 205-to-240 Vac line voltage source of 50 to 400 Hz. The test set operating voltage is indicated on the option plate at the rear of the test set case. Operating voltage is selectable with jumper wires located on circuit card A2 and bridge pads located under the labeled top cover of the display meter. Tables 1-2 and 1-3 provide voltage range adjustments.

To select meter operating voltage range, bridge pads specified in table 1-3 with solder as shown in figure 1-3.

Two soldered 0.5A fuses (F1 and F2) are located on circuit card A1 (see figure 5-5) to provide over-current protection and prevent damage to the test set.

1.1.2.4 Items Furnished. The items listed in table 1-4 are furnished with the Model 5440C NFTS.

1.1.2.5 Options Available. Options included in the Model 5440C Noise Figure Test Set are stamped on the identification plate located near the AC power connector. Table 1-5 provides a description of the options available.

NOTE

Noise sources will be supplied with +22V drive unless option 02 is ordered. With option 02, all noise sources ordered will be +28V drive.

1.1.2.6 Safety Precautions. This manual contains the following types of notices:

NOTE

Describes operating conditions required for accurate measurements or is used to delineate information.

CAUTION

Indicates any condition or practice which if not strictly observed could result in damage to the equipment.

WARNING

Indicates any condition or practice which if not strictly observed could result in personal injury or loss of life.

Table 1-2. Line Voltage Adjustment (Circuit Card A2)

TEST SET LINE VOLTAGE OPTIONS

LINE VOLTAGE	CONNECT PINS
95 to 125 Vac	1 to 2 and 3 to 4
205 to 240 Vac	2 to 3

Table 1-3. Line Voltage Adjustment (Digital Panel Meter)

METER LINE VOLTAGE OPTIONS

LINE VOLTAGE	BRIDGE PADS	ASSY. NO. 117
117 Vac	J,M,P,R	G1
220 Vac	K,N,R,	G2
100 Vac	L,M,R,K	G3
240 Vac	J,N,R	G4

Table 1-4. Items Supplied

ITEM	PART NO.
Attenuator, 10 dB	5930244P1
Attenuator, 20 dB	5930244P2
Adapter, SMA-to-N	21040
Cables, coaxial (2)	5930243P1
Line cord	P2392
Operation and Maintenance H-81-0323 Manuals (2)	5930812

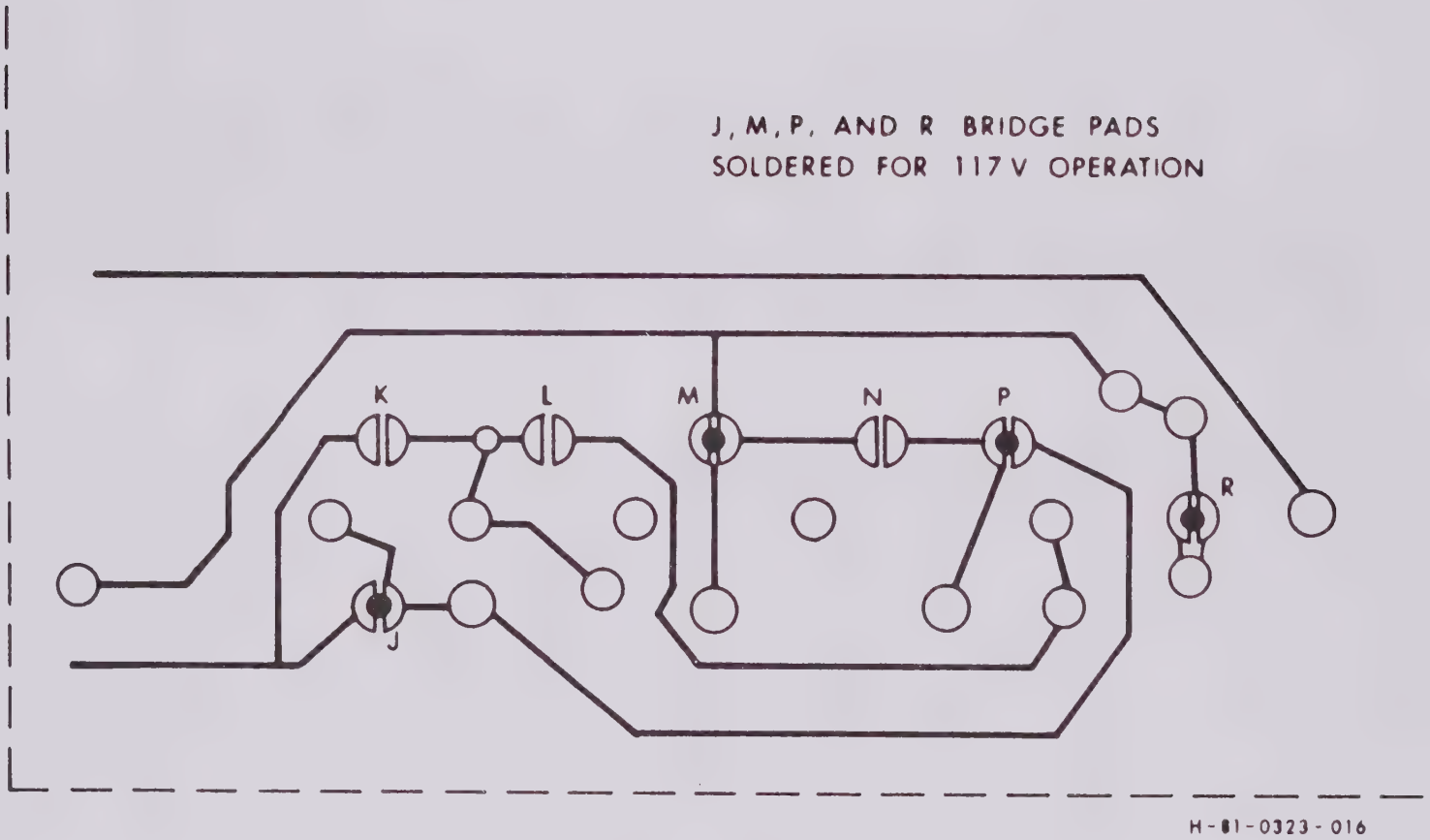


Figure 1-3. Typical Pad Configuration

Table 1-5. Options Available

Option 01:	-65 dBm IF Input Sensitivity
Option 02:	+28V, 50 mA Noise Source Drive
Option 03:	5 MHz-to-18 GHz Noise Source, 25.5 ± 0.75 dB excess noise
Option 04:	10 kHz-to-1 GHz Noise Source, 25.5 ± 0.5 dB excess noise
Option 05:	18 GHz-to-26.5 GHz Noise Source, 25.5 ± 2 dB excess noise
Option 06:	26.5 GHz-to-40 GHz Noise Source, 23 ± 3 dB excess noise
Option 07:	10—Turn IF Tune Control (standard after test set serial no. A0189)
Option 08:	Other IF Tuning Ranges—Consult Factory
Option 10:	Rack Mount Kit
Option 11:	-80 dBm IF Input Sensitivity
Option 12:	Special Modifications—Consult Factory

SECTION 2

PREPARATION FOR USE AND INSTALLATION

2.1 PREPARATION FOR USE

Model 5440C Noise Figure Test Set is a self-contained instrument consisting of an electrical unit and cover storage unit.

2.1.1 EQUIPMENT ACCESS. Two snap-on latches located on either side of the case hold the electrical unit and the cover unit together. The latch tabs are lifted to remove cover. The cover has a storage compartment containing power cable, noise source, attenuators, coaxial interconnecting cables, and technical manual. To gain access to the storage compartment, pull the black knob. The panel will fold down and expose the accessories. When closing storage compartment panel, pull on black knob so contact fingers of knob will be in the retracted position.

CAUTION

Damage may result to test set if not configured to be electrically compatible with the ac power source. Refer to paragraph 1.1.2.3 for details.

Verify the ON/OFF pushbutton of the test set is in the OFF position. Remove the ac line cord from the cover storage

compartment and connect to the receptacle on rear of the test set. Connect the other end of the line cord to the ac power outlet.

2.1.2 REMOVAL OF ACCESSORIES. To remove the accessories discussed in paragraph 2.1.1, gently pull the noise source and desired attenuator from the clips attached to inside of storage compartment door. Coaxial cables required for noise figure measurements should also be removed from the storage compartment.

2.2 INSTALLING TEST SET

The test set must be connected to the noise source. If an attenuator is required, it should be attached to the noise source and the combination installed at the antenna input of the receiving system under test. Figure 2-1 shows the typical test set installation required for noise figure measurements. The attenuator shown may not be required for all cases. When the attenuator is not required, the noise source is connected directly to the antenna input of the receiving system under test.

2.2.1 INSTALLING NOISE SOURCE AND ATTENUATOR. The following procedure describes the installation of the noise source.

1. Connect attenuator (if required) to SMA connector end of the noise source.

2. Disconnect antenna cable from receiving system under test.

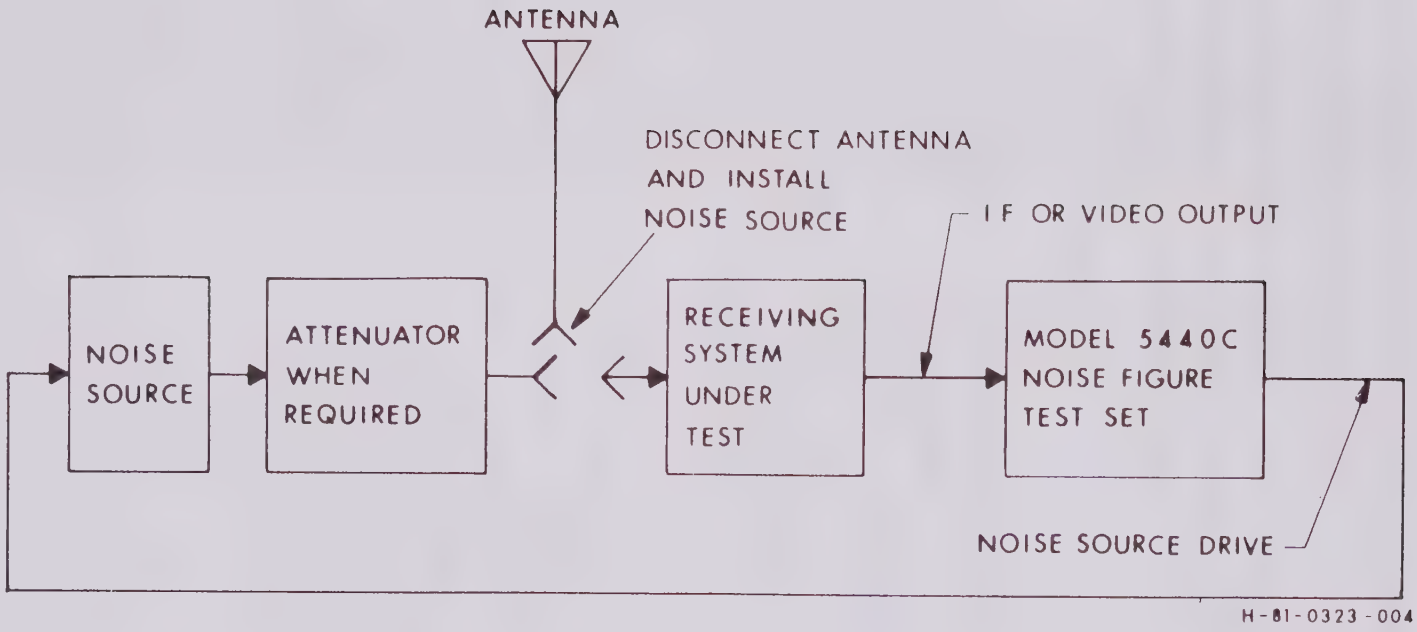


Figure 2-1. Simplified Noise Source Installation

3. Connect noise source assembly to receiving system antenna input connector as shown in figure 2-1.

4. Remove one coaxial cable from accessory compartment and connect between noise source BNC connector and NOISE SOURCE BNC connector on test set front panel.

NOTE

The noise source and attenuator assembly can be installed up to 300 feet from the test set. Permanent and multiple permanent noise source installations are also possible by using RF switching relays or directional couplers. Contact Sanders Associates Microwave Division for further information.

2.2.2 ATTENUATOR SELECTION. The noise source normally supplied with the test set has an excess noise ratio (N_{EX}) of 25.5 dB ± 0.75 dB relative to KTB. For optimum accuracy and to avoid saturating the receiver under test, it may be necessary to insert one of the attenuators supplied with the test set at the input of the receiver. Use table 2-1 to determine the selected value for the input attenuator based on the anticipated noise figure reading.

Table 2-1. Attenuator and N_{EX} Selection

ANTICIPATED NOISE FIGURE	ATTENUATOR INSTALLATION	N_{EX} PUSHBUTTON SELECTION
Less than 10 dB	20 dB	5 dB
10 to 20 dB	10 dB	15 dB
More than 20 dB	None	25 dB

CAUTION

The noise source is energized by +22V. Use of other power sources will cause inaccurate readings and possible damage to the noise source.

2.2.3 CORRECTED NOISE FIGURE VALUE. When a high degree of accuracy is required or the noise figure is below 5.0 dB or millimeter band noise sources are used, the noise source and attenuator tolerances must be considered. The test set includes noise source and attenuator calibration sheets listing actual values within 0.1 dB at specific frequencies. The test set is calibrated for excess noise values of 5.5, 15.5, and 25.5 dB. The effect of noise source and attenuator variations at a specific receiver operating frequency can be determined as follows:

1. Record the noise source corrected value at the frequency of interest from noise source calibration sheet.

2. Subtract the attenuator (if used) corrected value at the frequency of interest (obtained from attenuator calibration sheet) from the noise source corrected value and record the result.

3. Subtract the test set-calibrated N_{EX} value being used (5.5, 15.5, or 25.5) from the result obtained in step 2 and record the result (the value may be positive or negative).

4. Add the result obtained in step 3 to the value displayed on the test set to determine the corrected noise figure value.

SECTION 3

THEORY OF OPERATION

3.1 TEST SET OPERATION

3.1.1 FUNCTIONAL THEORY. Model 5440C Noise Figure Test Set is composed of two circuit cards (A1 and A2, figures FO-1 and FO-2), front panel controls, front panel indicators, and a noise source. Interconnections are shown in foldout FO-3.

Model 5440C Noise Figure Test Set (shown in functional diagram figure 3-2 and schematics FO-4 and FO-5), is capable of measuring the noise figure of receiving systems, traveling wave tubes, and amplifiers.

The test set normally measures the noise figure by utilizing the IF signal from the receiving system under test. A built-in preselector (continuously variable from 10 to 200 MHz) excludes spurious IF signals that may be present in the IF output of the receiving system under test. The IF section of the test set is AGC-controlled to ensure accurate signal levels over the entire operating range of the test set.

In some receiving systems, noise figure measurements can be made utilizing the receiver video output; however, IF measurements are preferred.

A test set noise source installed at the input of the receiving system under test is pulsed on and off by a 10-Hz square wave generator. Two sample and hold circuits (alternately enabled by the 10-Hz square wave generator) store values for N1 (noise source off) and N2 (noise source on). The N1 and N2 values are processed by log amplifier, summing amplifier, and analog amplifier circuits to produce a noise figure voltage. The noise figure voltage is applied to the digital panel meter to produce a noise figure readout calibrated in decibels.

Four LED indicators on the front panel indicate when the excess noise level or the input signal level is above or below levels required for accurate measurements.

3.1.1.1 Power Distribution. Primary power connector A1J2, fuses A1F1 and A1F2, and ON/OFF switch A1S1 are located on circuit card A1. Prime power jumper selection for power supplies is located on circuit card A2. Prime power jumper selection for panel display meter is located under the top-labeled cover of the display meter. AC prime power is applied via A1J2

through two series fuses and prime power switch S1A to the two power supplies and the panel display meter. Power supply 1 (PS1) produces +15V and -15V. The +15V from PS1 is applied to the +3V regulator circuit. The panel display meter produces +5V for circuit cards A1 and A2. Power supply 2 (PS2) produces +22V, (or +28V if option 02 is installed).

3.1.1.2 IF Signal Processing. The IF signal output of the receiving system under test (10 to 200 MHz) is applied to circuit card A2. The IF signal is applied through the input preamplifier Z3 (option 1 or 11) to mixer Z2. The mixer combines the IF signal with the voltage-controlled oscillator signal (D1, Q1) to produce a difference frequency of 45 MHz. The voltage-controlled oscillator is adjusted with the front panel IF TUNE control from 55 to 155 MHz.

NOTE

When the IF signal applied to the test set from the receiving system under test is approximately 105 MHz, the 45-MHz difference frequency is produced at two settings of the IF TUNE control. Either setting may be used.

The IF amplifier section is gain-controlled as part of a feedback loop from the N2 sample and hold circuit. The AGC bias is set and the AGC signal integrated by the gain control integrator circuit U3. The gain control integrator circuit and the AGC limiter/inverter circuit set the dynamic range at approximately 50 dB.

The 45-MHz difference frequency is detected by the IF detector and applied through the IF VIDEO switch on circuit card A1 to the video circuits to be processed as a video signal.

3.1.1.3 Video Signal Processing. The input to the video section is selected with the IF VIDEO pushbutton and applied to circuit card A1. The video section will process either a detected difference frequency from the IF section or a video signal from the receiving system under test. The signal is amplified by the video amplifier (Z1), squared by the square amplifier (Z10), amplified again by the buffer amplifier (Z2), and integrated by Z9. When the noise source is gated off, the integrator output has a value of N1. When the noise source is gated on, the integrator output has a value of N2. As shown in figure 3-1, the 100-Hz waveform from the 100-Hz oscillator is divided by 10 and produces a 10-Hz timing signal. Every transition of the 10-Hz timing signal triggers the HI/LO transition circuit (U5) producing alternate 25-μsec enable pulses every 50 msec. The 25-μsec pulses alternately enable sample and hold circuits N1 (Z3) and N2 (Z4). The HI-LO transition one shot also produces a 400-μsec integrator dump pulse that triggers the integrator dump circuit (Q6-8) via the dump pulse generator (U3) and dump driver (Q9). The integrator dump circuit and dual dump switch discharge the integrator between N1 and N2 samples. Differential (Z4) amplifier calculates N2-N1. Log amplifier (Z5) produces the value log (N2-N1/N1). Sum amplifier (Z6) converts the log level to the dc voltage equivalent of $N_{EX}{}^{10}$ log (N2-N1/N1).

When the IF TUNE/NF pushbutton is in the NF position (out), the output of sum amplifier (Z6) circuit is applied to the panel meter

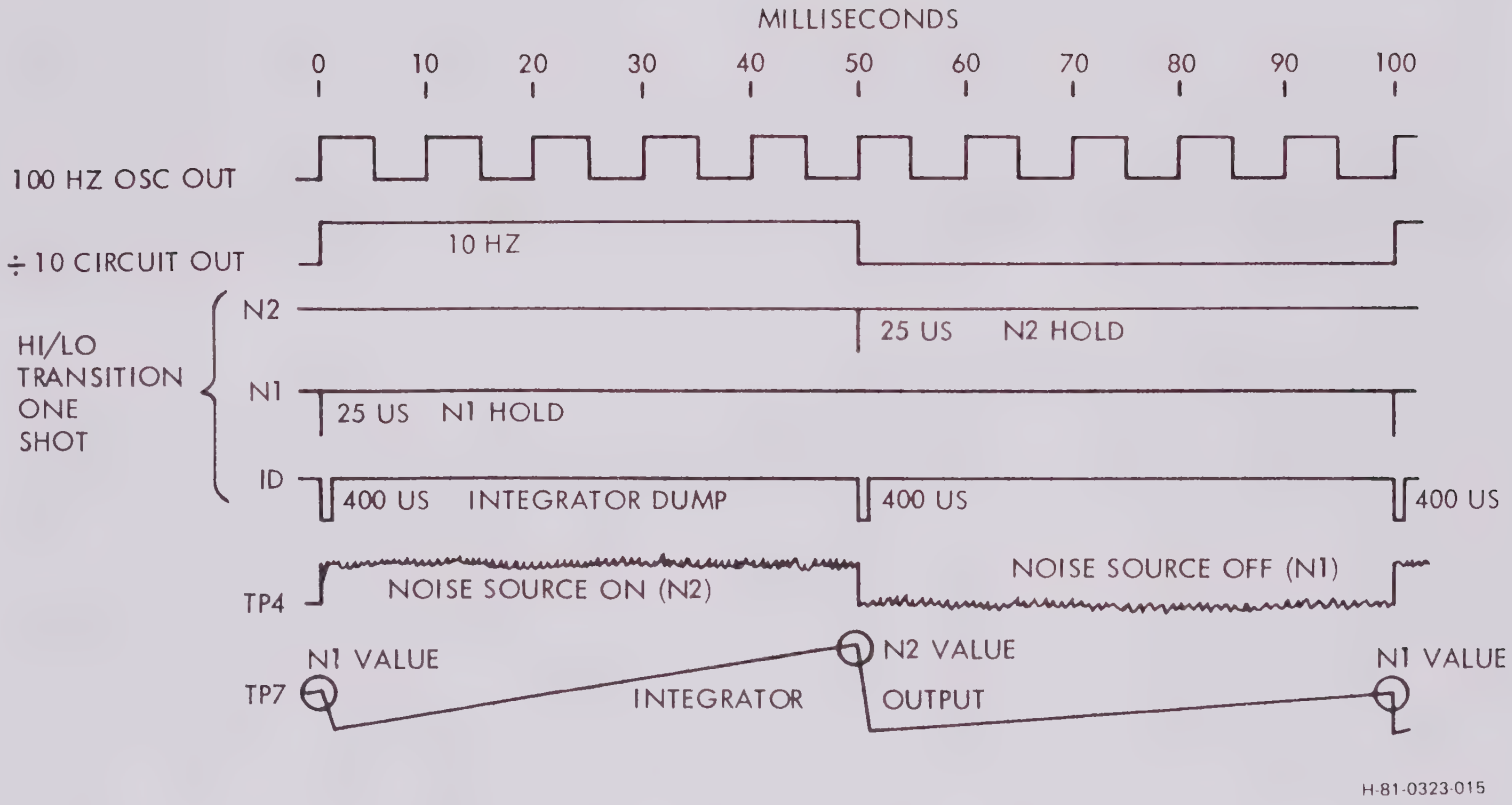


Figure 3-1. Timing Diagram

display for conversion to a numeric display. In addition, analog amplifier (Z7) applies the output of the sum amplifier to the ANALOG OUT jack via the CAL switch. The ANALOG OUT signal drives the Y axis of an external X-Y recorder. The CAL switch can also select a +3V calibration signal from regulator A1 U1 to calibrate the Y axis of the X-Y recorder. The X axis drive voltage is provided by the frequency tuning voltage from the receiving system under test.

3.1.1.4 N_{EX} Compensation. The attenuator control voltage circuit consists of three individual voltage divider circuits. As shown in figure 3-2, the selected N_{EX} pushbutton applies one of the control voltage outputs to the positive input of the sum amplifier circuit and sets the operating point of Z6 to correspond with the amount of excess noise applied to the unit under test.

The modulation select gate, U4C, receives the inverted 10-Hz squarewave from the ÷10 circuit and a dc enable voltage applied through the selected N_{EX} pushbutton. (The 10-Hz waveform can also be enabled by a 1-kHz waveform from the 1-kHz oscillator circuit (U6A, U6B) when all three N_{EX} pushbuttons are released (out)). The output of the modulation select gate is applied to enable the dump circuit U4B and triggers the driver circuit (Q3, Q4, Q5) when the IF TUNE/NF pushbutton is pressed.

3.1.1.5 Noise Source Drive. The noise source operates when +22V is applied. The output waveform from the modulation select gate is applied through the IF TUNE/NF switch to the driver circuit and the dump switch circuit. The output of the

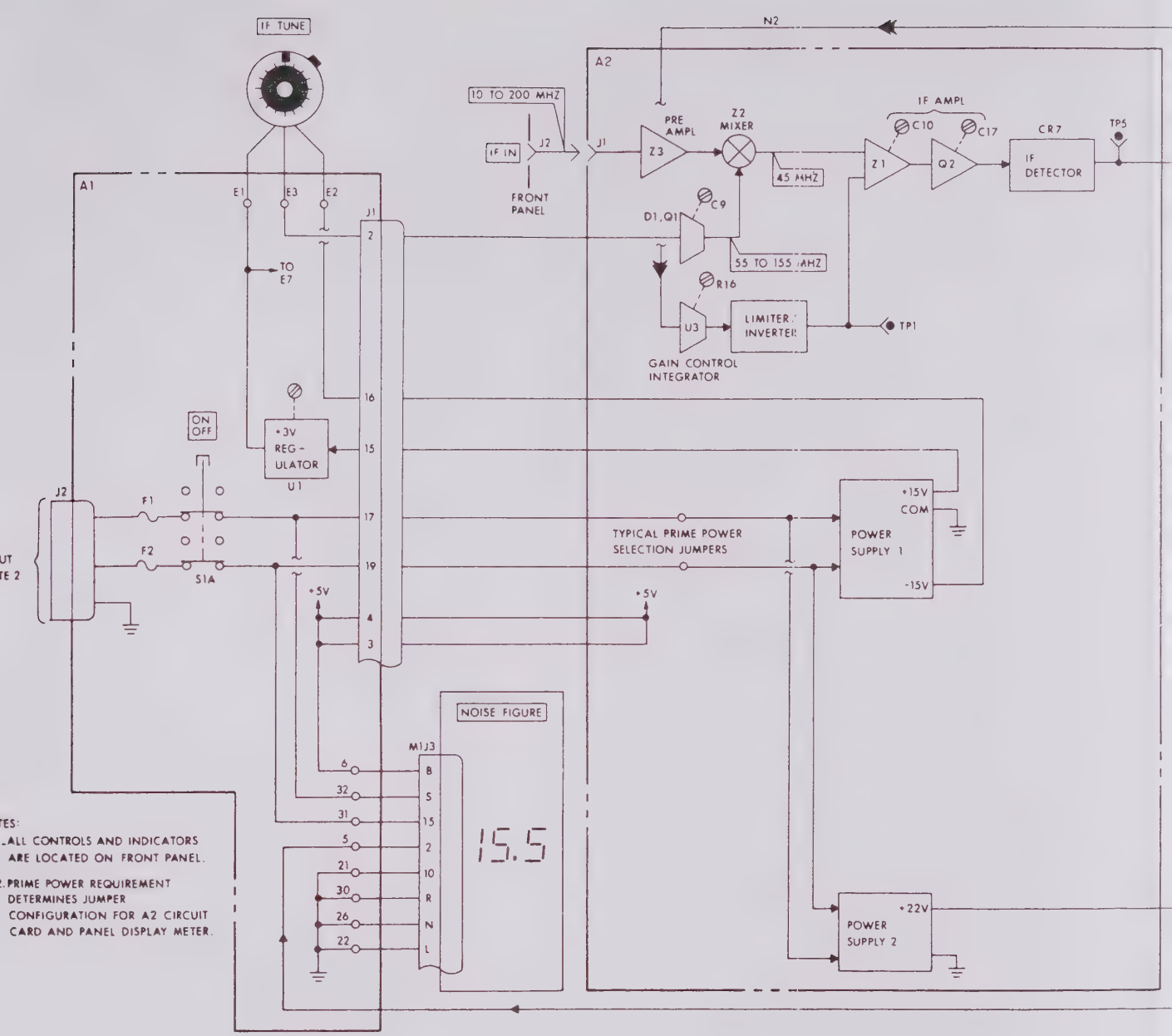
driver circuit triggers the drive switch to produce a modulated +22V noise source drive waveform. This modulated signal is applied to the noise source through the CAL switch. The dump switch circuit discharges the driver switch output to ground when the pulse from the modulation select gate circuit terminates.

When the CAL switch is in the CAL position (up), +22V is applied continuously to the noise source. With the CAL switch in the normal position (down), the noise source is pulsed on at a 10-Hz rate that is synchronized with the N2 sample and hold time.

3.1.2 FRONT PANEL INDICATORS. When the four LED indicators located on the front panel of the test set are off, the input levels from the receiving system under test and the excess noise level from the noise source are within the limits required for accurate noise figure measurements.

The value of LOG N2/N1 from the log amplifier A1, Z5 is applied to the negative input of the high noise comparator A2, U4a and the positive input of the low noise comparator A2, U4b. The value of LOG N2/N1 must be between -0.6V and +1.04V for accurate noise figure measurements. If the value is below -0.6V, the ratio between N2 and N1 is too large and the output of comparator U4a will go high. If the value of LOG N2/N1 is above +1.04V, the ratio between N2 and N1 is too small and the output of comparator U4b will go high.

The value of N1 from the N1 sample and hold circuit A1, Z3 is applied to the negative input of the low input comparator A2,



TES:
-ALL CONTROLS AND INDICATORS ARE LOCATED ON FRONT PANEL.

2. PRIME POWER REQUIREMENT DETERMINES JUMPER CONFIGURATION FOR A2 CIRCUIT CARD AND PANEL DISPLAY METER.

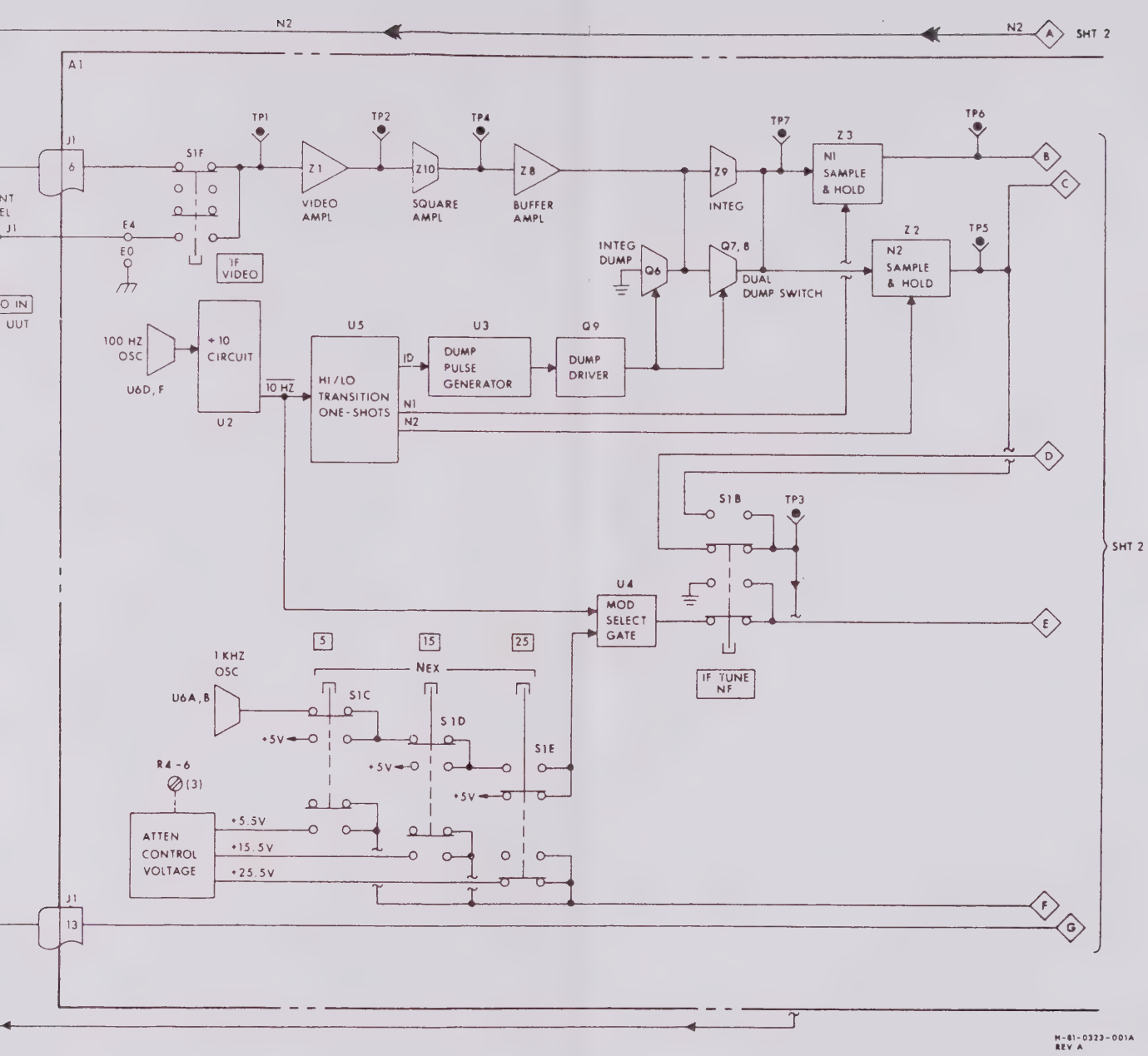
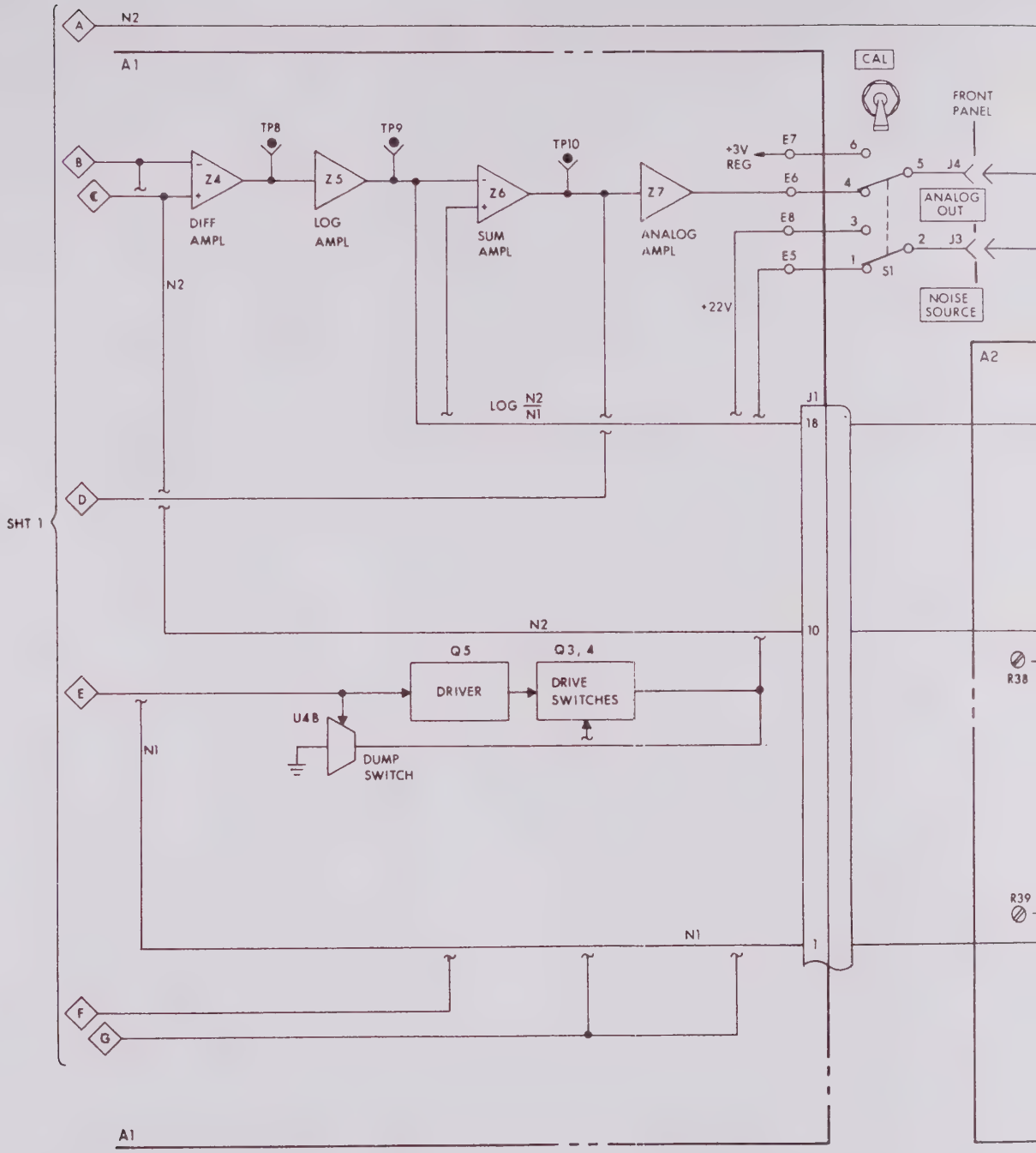


Figure 3-2. Functional Block Diagram
(Sheet 1 of 2)


A
N2
A1
CAL
FRONT PANEL
TP8
TP9
TP10
B
C
Z4
Z5
Z6
Z7
DIFF AMPL
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SUM AMPL
ANALOG AMPL
+3V REG
E7
E6
E8
E5
6
4
3
1
5
J4
2
J3
S1
ANALOG OUT
NOISE SOURCE
+22V
N2
A2
LOG N2/N1
J1
18
D
SHT 1
N2
10
Q5
Q3, 4
DRIVER
DRIVE SWITCHES
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N1
R38
R39
N1
1
F
G
A1

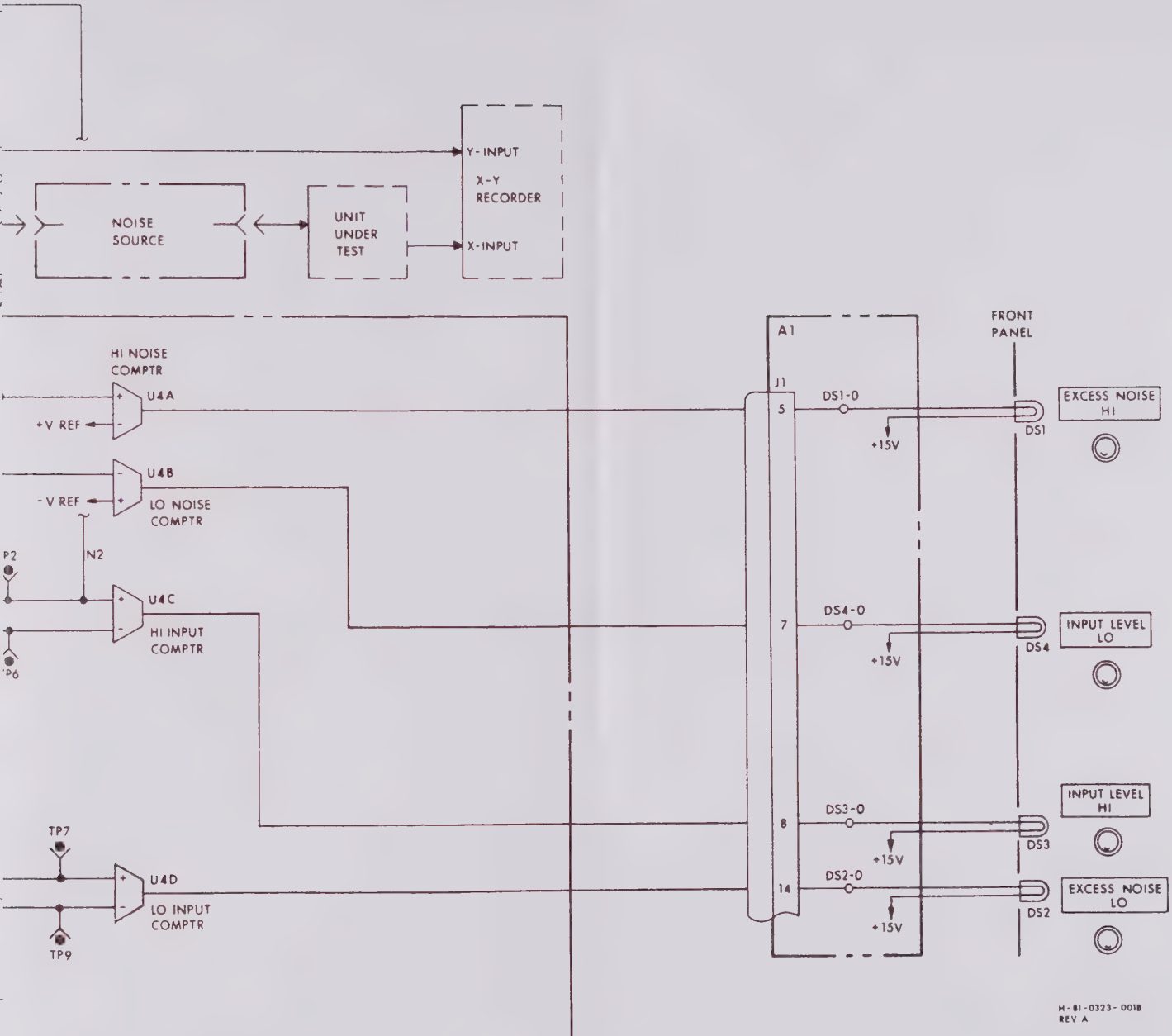


Figure 3-2. Functional Block Diagram
(Sheet 2 of 2)

SECTION 4

OPERATING INSTRUCTIONS

4.1 OPERATING INSTRUCTIONS

4.1.1 PROCEDURES AND INSTRUCTIONS. Each test set measurement requires connections between the test set and the receiving system under test. This section contains the following procedures and instructions.

1. Test set front panel controls, indicators, and connectors
2. IF noise figure measurement procedure
3. Video noise figure measurement procedure
4. Modulated noise source instructions
5. Instructions for plotting noise figure

NOTE

Special instructions for the AN/WLR-1 systems are found in Appendix A and paragraph 4-5.

4.1.2 TEST SET CONTROLS, INDICATORS, AND CONNECTORS. The INDEX column of table 4-1 references the controls, indicators, and connectors shown in figure 4-1. The DESCRIPTION column lists the panel names or markings for

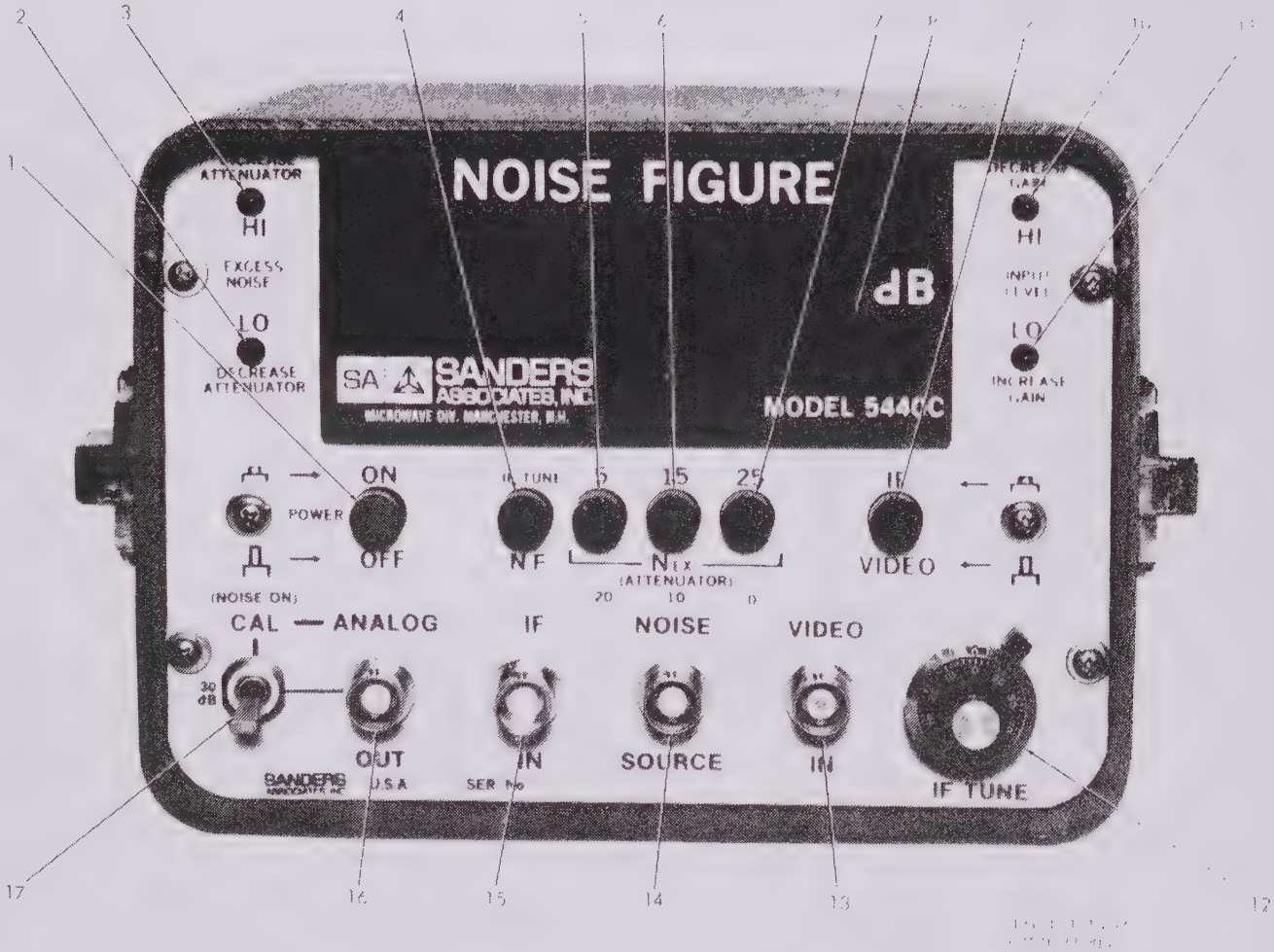


Figure 4-1. Front Panel Controls

various controls, indicators, and connectors. The use of each control, indicator, and connector is described in the FUNCTION column.

Table 4-1. Test Set Controls, Indicators, and Connectors

FIG. 4-1 INDEX	DESCRIPTION	FUNCTION
1	ON/OFF Power Switch	Controls AC power to test set. When depressed, power is on.
2	EXCESS NOISE LO indicator	Indicates the amount of excess noise from noise source to the unit under test is too low. Decrease attenuator at noise source and make appropriate N_{EX} pushbutton change.
3	EXCESS NOISE HI indicator	Indicates the amount of excess noise from noise source to the unit under test is too high. Increase attenuator at noise source and make appropriate N_{EX} pushbutton change.

Table 4-1. Test Set Controls, Indicators, and Connectors (Cont)

FIG. 4-1 INDEX	DESCRIPTION	FUNCTION
4	IF TUNE/ NF pushbutton	Selects either IF tuning mode or noise figure measuring mode of operation.
5	5 N_{EX} pushbutton	Adjusts test set to operate with a noise source output level of 5.5 dB.
6	15 N_{EX} pushbutton	Adjusts test set to operate with a noise source output level of 15.5 dB.
7	25 N_{EX} pushbutton	Adjusts test set to operate with a noise source output level of 25.5 dB.

NOTE

With all three N_{EX} pushbuttons out, the noise source will be modulated at a 1-kHz rate (see paragraph 4.5). Noise figure cannot be measured in this mode, the digital panel meter display will be meaningless.

Table 4-1. Test Set Controls, Indicators, and Connectors (Cont)

FIG. 4-1 INDEX	DESCRIPTION	FUNCTION
8	NOISE FIGURE Panel meter display	Indicates relative amplitude of IF input when the IF TUNE/NF pushbutton is depressed. This reading has no relation to specific absolute quantities. The dB label should be ignored. Indicates noise figure reading in decibels with IF TUNE/NF pushbutton out.
9	IF/VIDEO pushbutton	Selects IF mode for measuring noise figure (when depressed) or video mode for measuring noise figure with pushbutton out.
10	INPUT LEVEL HI indicator	Indicates IF or video input level to test set is too high (decrease IF or video gain of the receiver under test).

Table 4-1. Test Set Controls, Indicators, and Connectors (Cont)

FIG. 4-1 INDEX	DESCRIPTION	FUNCTION
11	INPUT LEVEL LO indicator	Indicates IF or video input level to test set is too low (increase IF or video gain of receiver under test.
12	IF TUNE control	Tunes test set to IF frequency of the receiver under test. Indication is displayed on panel meter.
13	VIDEO IN connector	Input connector to receive video signal from receiver under test in video mode.
14	NOISE SOURCE connector	+22V output to power noise source (+28V with option 02).
15	IF IN connector	Input connector to receive IF signal from receiver under test when in IF mode.

Table 4-1. Test Set Controls, Indicators, and Connectors (Cont)

FIG. 4-1 INDEX	DESCRIPTION	FUNCTION
16	ANALOG OUT connector	Analog voltage proportional to magnitude of noise figure (0.1 V/dB) to drive Y axis of X-Y plotter or general purpose analog DC voltmeter.
17	CAL switch (dual function)	In down position, test set is in normal operating mode. In up position, +3.0V (which represents a noise figure of exactly 30.0 dB for calibration of plotter Y axis) is applied to ANALOG OUT connector. Also applies a constant +22V (+28V with option 02 installed) to NOISE SOURCE connector for alignment and calibration.

4.2 IF NOISE FIGURE MEASUREMENT

4.2.1 NOISE FIGURE VALUE. When measuring the noise figure of a receiver with the test set, a preliminary noise figure value must be assumed. Use the typical noise figure value for the receiver type being tested. If the noise figure is not known, assume a preliminary value of 15 dB. The following steps describe how to measure the noise figure of a receiver using IF output

1. Using anticipated noise figure value, refer to table 2-1 for attenuator and N_{EX} value selection.

2. Install noise source and attenuator selected from table 2-1 at receiver RF input connector. Refer to figure 2-1.

3. Connect BNC cable supplied with test set from BNC noise source connector to test set front panel noise source connector.

NOTE

Noise source and attenuator can be installed up to 300 feet from test set. Permanent noise source installations are possible using RF switching relays or directional couplers. Contact Sanders Associates Microwave Division for further information.

4. Connect second BNC cable supplied with test set from the receiver IF output to the test set front panel IF IN connector.

5. Position test set front panel controls as follows:

a. Set IF/ VIDEO pushbutton to IF (depressed).

b. Depress N_{EX} pushbutton selected in step 1.

c. Set IF TUNE/ NF pushbutton to IF TUNE (depressed).

d. Set CAL switch to down position.

e. Set ON OFF pushbutton to ON (depressed).

NOTE

Model 5440C Noise Figure Test Set is supplied with either a single-turn or 10-turn IF TUNE control. Select the preliminary IF TUNE procedure that applies to your unit.

4.2.1.1 Single-Turn Control Preliminary IF Tune Procedure. Use tuning dial on test set front panel as a guide to pre-tune IF TUNE control to the approximate IF frequency of the receiving system under test.

NOTE

The two ranges indicated on the IF TUNE dial overlap (10 MHz to 110 MHz and 100 MHz to 200 MHz). Two responses are possible when the IF frequency is between 100 and 110 MHz. Either response may be used.

4.2.1.2 Ten-Turn Step Control Preliminary IF Tune Procedure. Use table 4-2 as a guide to pre-tune IF TUNE control to the approximate IF frequency of the receiving system under test.

NOTE

As shown in table 4-2, two responses are possible when the IF frequency is between 100 and 110 MHz. Either response may be used.

Table 4-2. IF Frequency, IF TUNE Dial Correlation

IF FREQUENCY	10-TURN DIAL INDICATION
10.7	0.40
15.0	0.65
21.4	1.20
30.0	1.90
60.0	5.80
90.0	7.30
105.0	8.30 or 0.60
160.0	6.50
200.0	9.00

4.3 IF TUNE PROCEDURE

NOTE

Ignore N_{EX} indicators when in IF tune mode.

1. Observe test set panel meter display and adjust IF TUNE control for maximum indication nearest the dial setting selected in preliminary IF tune procedure.

2. If panel meter indication is greater than 10 (for unit serial numbers up to AO238), reduce IF GAIN control of receiver under test until indication is less than 10. For unit serial numbers CO239 and up, this indication can go to 180.

3. Repeat steps 1 and 2 until a peak panel meter indication is within designated limits.

NOTE

If two peaks are indicated, adjust IF TUNE control for the larger peak.

4. Reduce IF GAIN control of receiver as low as possible while maintaining indication on display. Verify that only one response is present by tuning across entire range of test set IF TUNE control.

5. Readjust IF TUNE control for peak indication.

6. Increase IF GAIN control of receiver under test to a point where both INPUT LEVEL HI and LO indicators are extinguished.

Table 4-2. IF Frequency, IF TUNE Dial Correlation

IF FREQUENCY	10-TURN DIAL INDICATION
10.7	0.40
15.0	0.65
21.4	1.20
30.0	1.90
60.0	5.80
90.0	7.30
105.0	8.30 or 0.60
160.0	6.50
200.0	9.00

4.3 IF TUNE PROCEDURE

NOTE

Ignore N_{EX} indicators when in IF tune mode.

1. Observe test set panel meter display and adjust IF TUNE control for maximum indication nearest the dial setting selected in preliminary IF tune procedure.

NOTE

The standard test set requires IF IN power levels between -20 and -50 dBm. If option 01 has been installed, IF IN power levels must be between -35 and -65 dBm. It may be necessary to install an external amplifier or attenuator if proper IF IN power levels cannot be achieved using IF GAIN control of receiver under test.

8. Set IF TUNE/NF pushbutton to NF (out).

9. If either EXCESS NOISE indicator on test set front panel is on, make appropriate attenuator change at front end of receiver under test.

10. If attenuator (step 9) is changed, determine new N_{EX} value from table 2-1 and depress appropriate N_{EX} pushbutton.

NOTE

All four indicators on front panel of test set must be off to obtain accurate noise figure measurements.

11. Read NOISE FIGURE value from test set digital panel meter display.

4.4 VIDEO NOISE FIGURE MEASUREMENT

When measuring the noise figure of a receiver with the test set, a preliminary noise figure must be assumed. Use typical noise figure value for the receiver type being tested (if known) or assume a preliminary value of 15 dB. The following steps describe how to measure the noise figure of a receiver utilizing the video output.

NOTE

Noise figure measurements utilizing video output of a receiver can be inaccurate because of detector non-linearity in the receiver under test. The test set assumes that the detection process of the receiver under test is linear. Any deviation will cause erroneous readings. For example, a square law detector will cause the test set indication to be 3 dB lower than actual noise figure value.

1. Using selected noise figure value, refer to table 2-1 for attenuator and N_{EX} values.

2. Install noise source and attenuator specified at the RF input of the receiver as described in Section 2.2.1.

3. Connect one cable supplied with test set between BNC connector on noise source and front panel NOISE SOURCE connector.

NOTE

Noise source and attenuator can be installed up to 300 feet from test set. Permanent noise source installations are possible using RF switching relays or directional couplers. Contact Sanders Associates Microwave Division for further information.

4. Connect second cable supplied with test set between VIDEO OUTPUT of receiver under test and front panel VIDEO IN connector.

5. Position test set front panel controls as follows:

a. Set IF/VIDEO pushbutton to VIDEO.

b. Depress appropriate N_{EX} pushbutton.

c. Set IF TUNE/NF pushbutton to NF.

d. Set CAL switch to down position.

e. Set ON/OFF pushbutton to ON.

6. Adjust VIDEO GAIN control of receiver under test until INPUT LEVEL HI and LO indicators are off.

NOTE

The HI and LO indicator levels are set as follows; LO level illuminates at a video input level of less than 40 mV TRMS, HI level illuminates at a video input of 90 mV TRMS or greater. With a 20-kHz noise bandwidth, this represents power levels of approximately -23 to -15 dBm.

7. If either EXCESS NOISE indicator is on, make appropriate attenuator change at front end of receiver under test.

8. If attenuator is changed, determine new N_{EX} value from table 2-1 and depress corresponding N_{EX} pushbutton.

NOTE

All four indicators on test set front panel must be off to obtain accurate noise figure measurements. Rotate the IF TUNE control to determine that IF TUNE control has no effect on noise figure value. If the IF TUNE control affects the noise figure indication, set the IF tune control to a point where the meter indication is unaffected.

9. Read noise figure value from digital panel meter display.

10. Set ON/OFF pushbutton to OFF and return receiver to normal condition.

4.5 MODULATED NOISE SOURCE

The test set contains a modulator that turns the noise source on and off at a 1-kHz rate. This modulated noise source provides modulated input to align the RF and IF amplifiers found in some receiving systems. Use the following procedure to select the 1-kHz modulated noise source;

NOTE

When in the 1-kHz mode, the test set does not measure noise figure and any meter indication is meaningless.

1. Connect noise source to input of receiver as described in Section 2.2.1.

2. Connect cable between noise source and NOISE SOURCE connector on test set front panel.

3. Release all three N_{EX} pushbuttons to initiate modulated noise source and set CAL switch down.

4. Set the ON/OFF pushbutton to ON.

5. Connect receiving systems IF or video output to oscilloscope and adjust receiver as required.

6. Depress any N_{EX} pushbutton to turn off the 1-kHz modulation.

4.6 PLOTTING NOISE FIGURE VERSUS RECEIVER FREQUENCY

NOTE

The tuning output voltage of some receivers may be a negative value corresponding to the lowest frequency, and a positive voltage corresponding to the highest frequency of a band to be tested. If this is the case, refer to alternate plotting procedure, Section 4.7.

1. Connect test set and receiver under test to X-Y recorder as shown in figure 3-2. Do not connect test set to the receiver being tested until step 8 of this procedure has been completed.

2. Set CAL switch down and ON OFF pushbutton to ON.

3. Adjust Y axis ZERO control until recorder pen is aligned with line on graph paper that represents zero dB.

4. Set CAL switch up and adjust Y axis GAIN control until recorder pen is aligned with line on graph paper that represents 30 dB.

5. Repeat steps 2, 3, and 4 until zero and 30 dB points are positioned correctly.

6. With receiver under test tuned to lowest frequency being measured, adjust X axis ZERO control until recorder pen is aligned with line on graph paper that represents minimum frequency.

7. With receiver under test tuned to highest frequency being measured, adjust X axis GAIN control until recorder pen is aligned with line on graph paper that represents maximum frequency.

8. Repeat steps 6 and 7 until minimum and maximum points are positioned correctly.

9. Connect test set to receiver under test according to IF or video noise figure measurement procedure selected.

10. Tune the receiver under test to approximately mid-frequency band and measure noise figure.

11. Tune receiver to low end of frequency band. Lower pen of recorder.

12. Slowly tune receiver across frequency band to plot noise figure versus receiver frequency.

13. Raise pen and turn off plotter and test set.

4.7 ALTERNATE PROCEDURE FOR PLOTTING NOISE FIGURE VERSUS RECEIVER FREQUENCY

NOTE

This procedure is used when the tuning output voltage is negative for low frequency and positive for high frequency within a band under test. For receivers with normal output refer to Section 4.6.

1. Connect test set and receiver under test to X-Y recorder as shown in figure 3-2. Do not connect test set to the receiver being tested until step 9 of this procedure has been completed.

2. Set CAL switch down and ON/OFF pushbutton to ON.

3. Tune the receiver to the center frequency of the band to be tested.

4. Adjust receiver zero control until the recorder pen is aligned with the center line of the recorder paper.

5. Tune the receiver to lowest frequency to be measured.

6. Adjust recorder X-AXIS GAIN control so that the pen is aligned on the line of the recorder paper that represents the lowest frequency of the receiver band to be tested.

7. Repeat steps 3 through 6 unit center and minimum frequency points are correctly positioned.

8. Tune the receiver to the highest frequency to be measured. Verify that the recorder pen is aligned with the line of the graph paper which corresponds to the maximum frequency to be measured.

9. Repeat steps 3 through 8 until minimum and maximum points are positioned correctly.

10. Connect test set to receiver under test according to IF or video noise figure measurement procedure selected.

11. Tune the receiver under test to approximately mid-frequency band and measure noise figure.

12. Tune receiver to low end of frequency band. Lower pen of recorder.

13. Slowly tune receiver across frequency band to plot noise figure versus receiver frequency.

14. Raise pen and turn off recorder and test set.

SECTION 5

MAINTENANCE

5.1 MAINTENANCE DESCRIPTION

This section contains information related to unit test, disassembly/assembly, alignment, and test procedures.

5.1.1 VERIFICATION TEST. Unit test is a verification procedure that determines if the test set is functioning properly. This procedure requires no disassembly of the unit. The unit test verifies test set operation by comparing the test set output to results obtained using an alternate power meter noise figure measurement technique.

5.1.2 DISASSEMBLY/ASSEMBLY. The assembly/disassembly procedure describes disassembly of the test set including removal from the case, separation of the subassemblies, and removal of the panel display meter. Assembly of the test set is performed by reversing the disassembly procedure.

5.1.3 ALIGNMENT. The alignment procedure consists of adjustments and measurements performed on individual elements of the test set.

5.2 TEST EQUIPMENT REQUIRED

Instructions for setting up and adjusting the test equipment used for test set verification are described in this section. The test equipment required for alignment and testing is specified either by the parameters required or by the manufacturer's name and model number.

The following test equipment is required to test and align the test set.

1. Digital voltmeter, 4-1/2 digit resolution with DC and true RMS AC volts.

2. Two regulated power supplies, 0-30 volts with fine voltage control.

3. VHF signal generator, Hewlett-Packard 608E or equivalent.

4. Noise generator, General Radio 1390B or A.

5. Attenuators, VHF fixed 10 dB with BNC connectors.

6. Two step attenuators, VHF, Texscan SA-58 or equivalent.

7. RF power meter, Hewlett-Packard 436A with Hewlett-Packard 8484A sensor or equivalent.

8. Spectrum analyzer, Hewlett-Packard 8551B or equivalent.

9. Oscilloscope, Tektronix 465 or equivalent.

10. Mixer, VHF general purpose; Mini-Circuits ZAD-2H or equivalent.

11. Solid state switch, Sanders Associates 5930242 or equivalent. Contact Sanders Associates Microwave Division for further information.

12. Attenuator, variable, Weinschel 910-10-11 or equivalent.

13. Sweep generator, Telonic or equivalent.

14. Miscellaneous jumpers, clip leads, and BNC tee adapter.

5.3 UNIT TEST

5.3.1 TEST SETUP; ALIGNMENT PROCEDURE. The following steps describe how to connect the test equipment and calibrate the setup as required for test set verification.

1. Connect test equipment as shown in figure 5-1.

2. Set VHF signal generator to 160 ± 5 MHz at an output level of +7 dBm ± 2 dB.

3. Set noise generator bandwidth to 500 kHz at maximum output level.

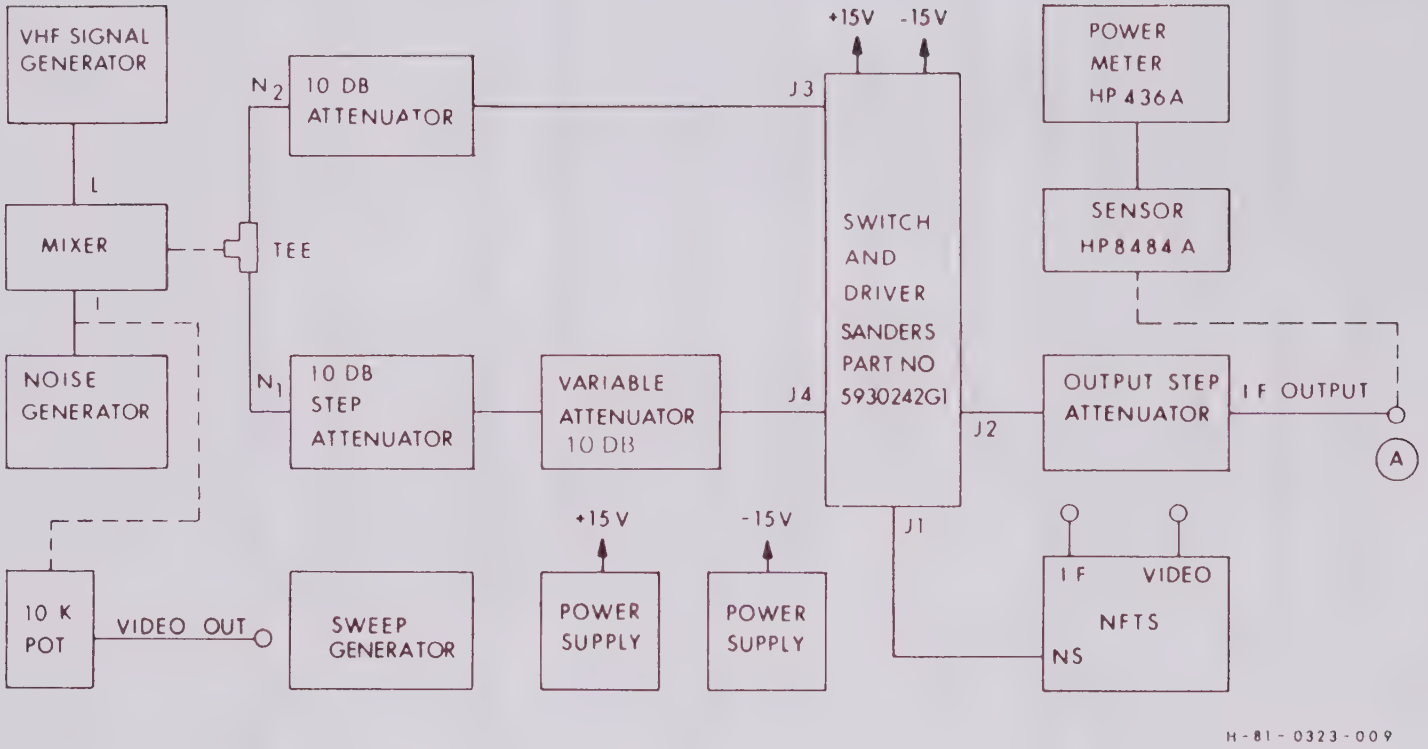


Figure 5-1. Test Setup Block Diagram

4. Depress test set IF/VIDEO pushbutton.

5. Depress test set IF TUNE/NF pushbutton.

6. Press test set N_{EX} 15 pushbutton.

7. Connect cable from J1 of test setup switch and driver assembly to test set front panel NOISE SOURCE connector.

8. Set step attenuator at 10 dB.

9. Set variable attenuator at 3 dB.

10. Set output step attenuator at 20 dB.

11. Connect power meter sensor to IF OUTPUT test point of the test setup.

12. Set test set CAL switch to CAL (up).

13. Note that power meter reading is approximately -40 dBm ± 3 dB.

14. Set CAL switch to normal position (down).

15. Adjust variable attenuator until power meter reads exactly 3 dB less than reading in step 13.

16. Repeat steps 13, 14, and 15 for verification. With completion of all steps, the test setup is now calibrated so that, N_2/N_1 = 3 dB. If the IF OUTPUT test point of the test setup is attached to the test set IF IN connector and a noise figure measurement is made using the IF noise figure measurement procedure, then NF = N_{EX} pushbutton selected.

5.3.2 TEST SET VERIFICATION PROCEDURE

1. Ensure that test equipment is connected as shown in figure 5-1 and that test setup alignment procedure in paragraph 5.3.1 has been performed.

2. Connect coaxial cable from test setup IF OUTPUT to test set IF IN connector.

3. Set test set CAL switch to normal position (down).

4. Depress test set IF/VIDEO pushbutton.

5. Depress test set IF TUNE/NF pushbutton.

6. Press N_{EX} 15 pushbutton.

7. Connect cable from J1 of test setup switch and driver assembly to test set front panel NOISE SOURCE connector.

8. Adjust test set IF TUNE control to select highest indication on digital panel meter display.

9. Increase test setup OUTPUT STEP ATTENUATOR as required to obtain a peak reading on the digital panel meter display of less than 10 (see IF Noise Figure Measurement, Section 4, paragraph 4.3 IF Tune Procedure Steps 1, 2, and 3).

10. Set output step attenuator to 20 dB.

11. Release IF TUNE/NF pushbutton (out).

12. Verify that all four test set LED indicators are off.

13. Record noise figure as displayed on digital panel meter display.

14. Depress IF TUNE/NF pushbutton.

15. Connect power meter sensor to test setup IF OUTPUT.

16. Read N1 power level in watts on power meter and record value.

17. Set CAL switch to CAL (up).

18. Read N2 power level in watts on power meter and record value.

19. Calculate noise figure as follows:

$$NF = 15.5 - 10 \log \frac{N_2}{N_1} - 1$$

NOTE

If the power levels called out in the test setup alignment procedure are used (N_2/N_1 = 3 dB), the noise figure reading will equal the N_{EX} pushbutton selected (15.5 dB, in this case).

20. Calculated noise figure shall be within ±0.5 dB ±5% of value recorded in step 13.

5.4 DISASSEMBLY/ASSEMBLY

5.4.1 DISASSEMBLY PROCEDURE

1. Remove AC line cord from connector at rear of test set.

2. Remove four front panel 4-40 Phillips screws and washers.

3. Remove two 6-32 Phillips screws and washers at rear of test set.

4. Grasp rear of test set with one hand and hold front panel with other hand.

5. Tip test set forward and slide test set assembly out. AC connector may have to be pushed with eraser end of wooden pencil for release.

5.4.2 SUBASSEMBLY SEPARATION

1. Set test set upside down.

2. Remove four 4-40 Phillips screws that hold two circuit cards together. Do not let circuit card A2 fall.

3. Set test set main frame on side with CAL switch side down (see figure 5-2).

4. Carefully lay circuit card A2 component side up on bench alongside test set main frame.

5.4.3 DIGITAL PANEL METER REMOVAL/INSTALLATION.

The digital panel meter is coded to indicate proper line voltage. Check G number of replacement meter before installing.

CAUTION

Replacing digital panel meter with improper G number may cause damage to the meter.

BE SURE TO USE CORRECT LINE VOLTAGE!

For G1 configuration, use 115 Vac ± 10%

For G2 configuration, use 220 Vac ± 10%

For G3 configuration, use 100 Vac ± 10%

For G4 configuration, use 240 Vac ± 10%

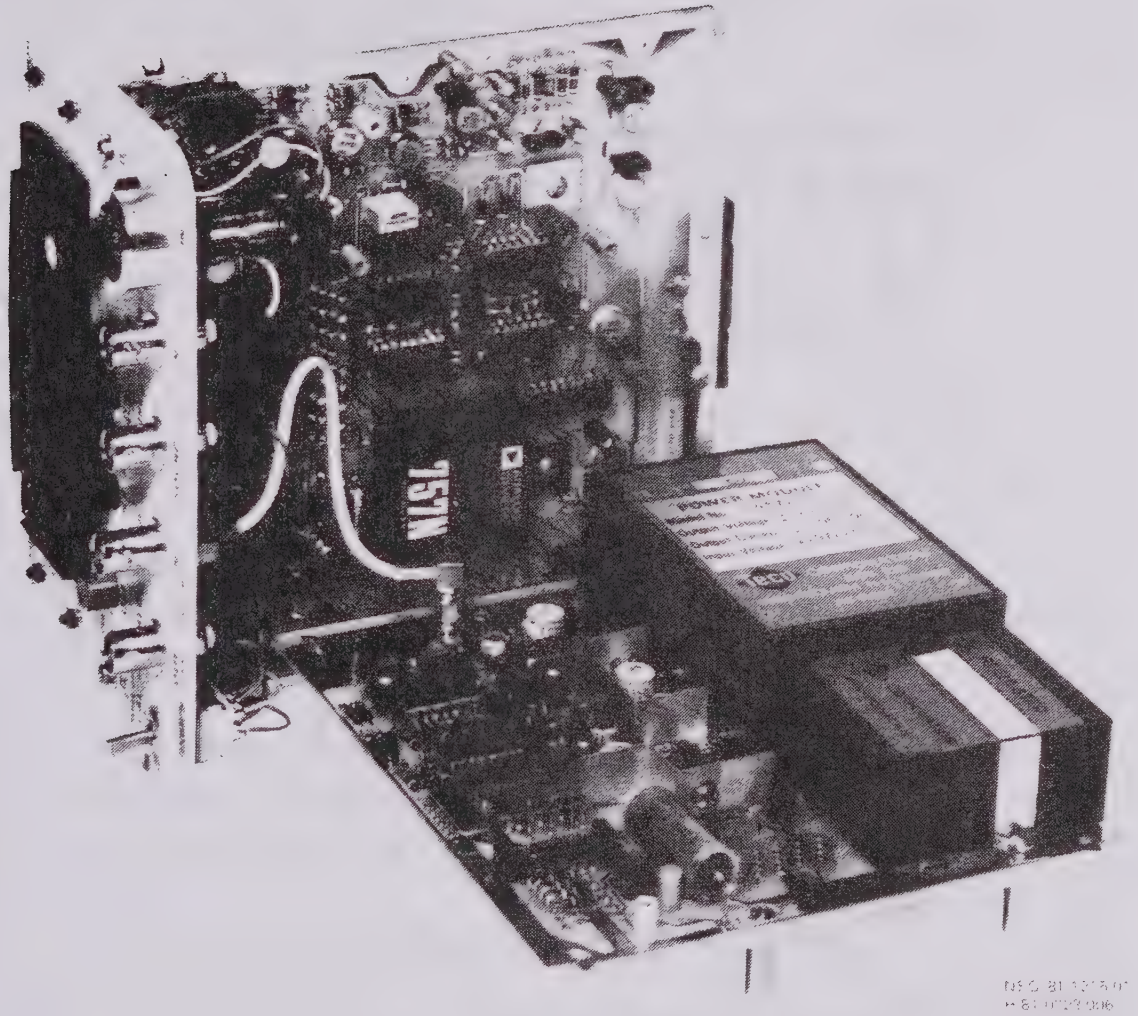


Figure 5-2. Subassemblies Separated

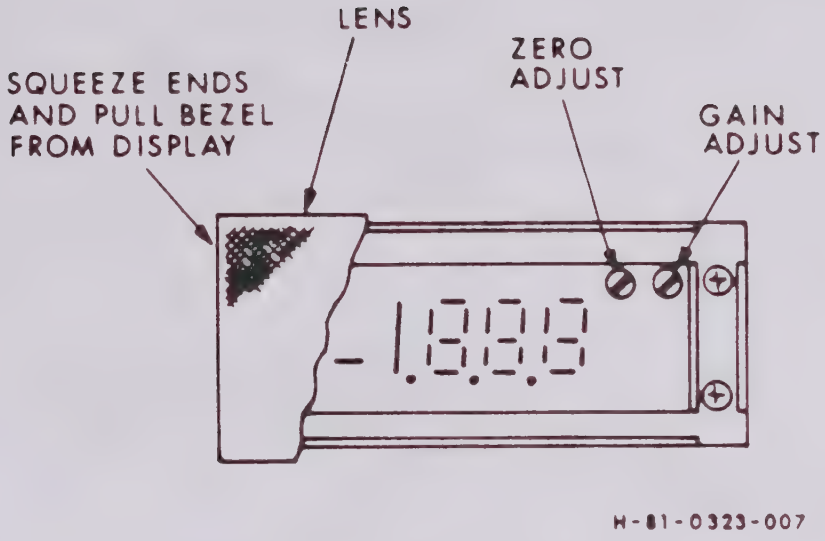


Figure 5-3. DPM Adjustments

1. Remove lens from front of digital panel meter as shown in figure 5-3.

2. Disconnect connector at rear of meter and remove two screws that secure meter to brackets on circuit card A1 as shown in figure 5-4.

3. Loosen mounting block tension screws.

4. Remove snap in mounting blocks by carefully prying out with a screwdriver.

5. Slide meter out through front of panel.

6. Installation is reverse of removal.

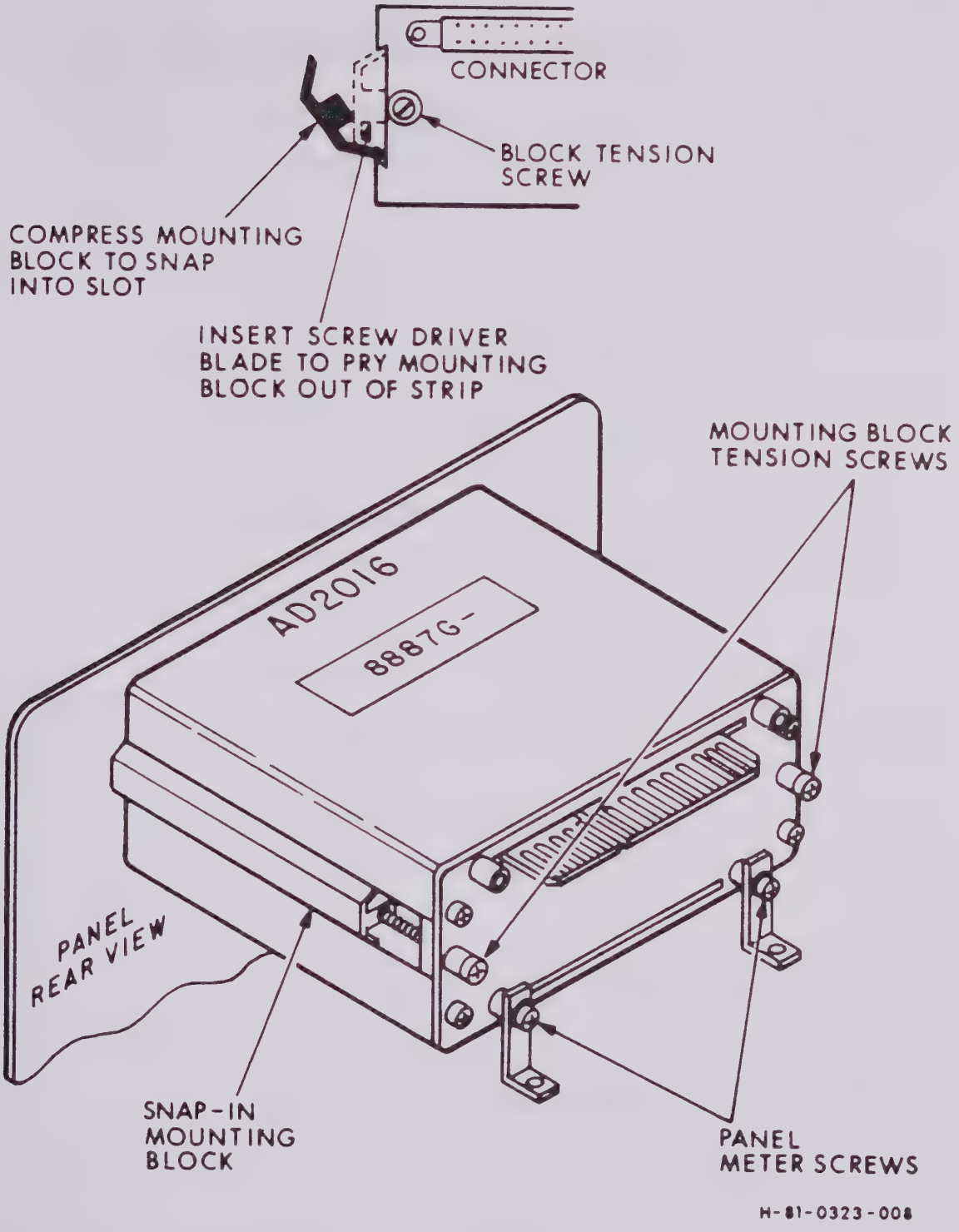


Figure 5-4. Panel Meter Installation

7. Using digital voltmeter (DVM) check power supply voltages at following locations (see FO-1 and FO-2). Use ground lug under VIDEO connector for all measurements.

a. +15V on collector case of A2Q2

b. -15V on A2R22 lead

c. +5V on the positive end of A1C18

d. +22V at center pin of noise source connector with CAL switch set to CAL. (Reset CAL switch to down position after voltage measurement is completed.)

5.5.2.1 Digital Panel Meter Zero Adjustment.

1. Ground orange test point A1TP3.

2. Adjust ZERO ADJUST potentiometer (shown in figure 5-3) until digital panel meter indicates 0.00.

3. Remove ground from A1TP3.

5.5.2.2 Integrator A1Z9 Offset Adjustment.

1. Depress IF TUNE/NF pushbutton.

2. Adjust A1R49 until panel display meter indicates 00.0.

5.5.2.3 Regulator A1U1 Adjustment.

1. Connect DVM to ANALOG OUT connector center pin.

2. Set CAL switch to CAL (up).

3. Place IF TUNE control to center position.

4. Adjust A1R2 for indication of +3.00 ± 0.01V.

5. Disconnect DVM. Set CAL switch to normal position (down).

5.5.2.4 Amplifier A1Z6 Alignment.

1. Ground white test point A1TP9.

2. Release IF TUNE/NF pushbutton (out).

3. Press N_{EX} 25 pushbutton.

4. Adjust A1R4 for indication of 25.5 ± 0.1 on digital panel meter.

5. Press N_{EX} 15 pushbutton.

6. Adjust A1R5 for indication of 15.5 ± 0.1 on digital panel meter.

7. Press N_{EX} 5 pushbutton.

8. Adjust A1R6 for indication of 5.5 · 0.1 on digital panel meter.

9. Remove ground from A1TP9.

5.5.2.5 AGC Operating Point Adjustment.

1. Connect DVM to orange test point A2TP3.

2. Adjust A2R16 for indication of -2.80 · 0.01V.

3. Disconnect DVM from A2TP3

5.5.2.6 Front Panel Lamp Threshold Adjustment.

1. Connect DVM to blue test point A2TP6.

2. Adjust A2R38 for indication of +3.20 · 0.01V.

3. Connect DVM to violet test point A2TP7.

4. Adjust A2R39 for indication of +0.50 · 0.01V.

NOTE

For unit serial numbers CO239 and up adjust A2R39 for indication of +2.6V · 0.01V.

5.5.2.7 VCO Range Adjust.

NOTE

The test set VCO frequency can be observed via the IF IN connector on front panel.

1. Connect test set IF IN connector to spectrum analyzer input using cable.

2. Set IF TUNE control fully CW.

3. Adjust spectrum analyzer frequency until IF signal is centered on analyzer display. Spectrum analyzer shall read at least 155 MHz or more.

4. Adjust A2C9 for best overall performance (not usually required).

5. Set IF TUNE control fully CCW. Adjust spectrum analyzer frequency until IF signal is centered on analyzer display. Spectrum analyzer shall read 55 MHz or less.

6. Place IF TUNE control at mid-range and disconnect IF IN cable.

5.5.2.8 IF Amplifier/Driver Alignment.

1. Set sweep generator for a center frequency of approximately 160 MHz.

2. Set sweep generator sweep width to 10 MHz per division.

3. Connect sweep generator video input to green test point A2TP5.

4. Connect sweep generator horizontal output to external horizontal input of oscilloscope (channel 1 or X input connector on Tektronix 465B).

5. Connect sweep generator vertical output to vertical input of oscilloscope (channel 2 or Y input connector on Tektronix 465B).

NOTE

Refer to X-Y Display instructions in oscilloscope operator's instruction manual for external horizontal operating procedures.

6. Set attenuator on sweep generator attenuator to 50 dB.

7. Set spectrum analyzer for 115 MHz center frequency.

8. Connect cable from test set IF IN to spectrum analyzer input. Adjust IF TUNE control on test set until IF frequency is centered on spectrum analyzer display.

9. Disconnect cable from spectrum analyzer and connect to sweep generator RF output.

10. Set signal generator to 160 MHz and connect cable from signal generator output to sweep generator MARKER IN connector. Adjust generator level for suitable marker display on oscilloscope.

11. Observe oscilloscope and adjust A2C10 and A2C17 to achieve best symmetry and maximum amplitude within ±3 MHz of the 160-MHz marker. Repeat A2C10 and A2C17 adjustments until best results are obtained.

NOTE

If circuit oscillates during adjustment, decrease amplitude by detuning until oscillation stops.

12. When adjustment is completed, center frequency should be within ±3 MHz of 160-MHz marker displayed on oscilloscope. Bandwidth should be 0.8 MHz nominal.

13. Disconnect all equipment from test set.

14. Perform IF amplifier gain test.

5.5.2.9 IF Amplifier Gain Test.

1. Connect test equipment as shown in figure 5-1.

2. Calibrate test setup according to test setup calibration procedure.

3. Connect cable from test setup IF OUTPUT to test set IF IN connector.

4. Depress test set IF/VIDEO pushbutton.

5. Depress test set IF TUNE/NF pushbutton.

6. Depress test set N_{EX} 15 pushbutton.

7. Connect cable from J1 of test setup switch and driver assembly to front panel NOISE SOURCE connector.

8. Adjust test set IF TUNE control to select highest indication on panel display meter.

9. Increase test setup output step attenuator as required to obtain a peak reading on Digital Panel Meter (DPM) of less than 10 (see IF noise figure measurement, Section 4, paragraph 4.3 IF Tune Procedure).

10. Set output step attenuator to 20 dB and observe INPUT LEVEL LO indicator is out.

11. Adjust test setup output step attenuator so that INPUT LEVEL LO indicator goes out. Signal generator output level attenuator may be used for fine adjustment.

12. Disconnect IF OUTPUT cable from test set and connect it to power meter. The measured output level shall be -50 dBm or less (-65 dBm with option 01, -80 dBm with option 11).

13. Disconnect all equipment from test set.

5.5.2.10 Noise Source Timing.

1. Release IF TUNE/NF pushbutton.

2. Set CAL switch to normal position (down).

3. Press N_{EX} 15 pushbutton.

4. Connect a BNC tee adapter to NOISE SOURCE connector.

5. Connect cable from NOISE SOURCE connector to one side of BNC tee adapter.

6. Connect cable from other side of adapter to oscilloscope input.

7. Verify square wave displayed on the oscilloscope meets following requirements.

a. Low voltage — +1V max.

b. High Voltage — +22 ± 1V (+28V ± 1 vdc if option 02 is installed).

c. On time — 50 ± 20 msec.

d. Off time — 50 ± 20 msec.

8. Release all three N_{EX} pushbuttons.

9. Verify square wave displayed on oscilloscope meets the following requirements.

a. Low voltage — +1V max.

b. High voltage — +22 ± 1V (+28V ± 1 vdc if option 02 is installed).

c. On time — 500 ± 105 μsec.

d. Off time — 400 ± 105 μsec.

SECTION 6

ELECTRICAL PARTS LIST

6.1 PARTS LIST DESCRIPTION.

This section contains a parts identification list for the Model 5440C Noise Figure Test Set (NFTS).

Tables 6-1 through 6-4 contain descriptions of the items, reference designations, part numbers and manufacturer code numbers. Table 6-1 lists all major components of the test set. Table 6-2 lists all the front panel components. Table 6-3 lists all test set components on circuit card A1. Table 6-4 lists all test set components on circuit card A2. Table 6-5 is a complete index of component manufacturers including name and address and manufacturer code numbers

Table 6-1. Noise Figure Test Set
Electrical Parts List

REF DES	PART NO.	DESCRIPTION	MFR CODE
REF	5930206G1	MODEL 5440C, 117 VAC	31637
REF	5930206G2	MODEL 5440C, 220 VAC	31637
REF	5930206G3	MODEL 5440C, 100 VAC	31637
REF	5930206G4	MODEL 5440C, 240 VAC	31637
—	5930208G-	Front panel assembly (see table 6-2)	31637
A1	5930211G1	Circuit card #1 (see further breakdown)	31637
A2	5930216G-	Circuit card #2 (see further breakdown)	31637
—	1056828P1	Noise source	94117
—	5930244P1	Attenuator, 10 dB	31637
—	5930244P2	Attenuator, 20 dB	31637
—	21040	Adapter, SMA-to-N	16179
—	5930243P1	Cables, coaxial (2 ea)	31637
—	P2392	Line cord	82389

Table 6-2. Front Panel Assembly
Electrical Parts List

REF DES	PART NO.	DESCRIPTION	MFR CODE
REF	5930208G1	Front panel assembly, 117 Vac	31637
REF	5930208G2	Front panel assembly, 220 Vac	31637
REF	5930208G3	Front panel assembly, 100 Vac	31637
REF	5930208G4	Front panel assembly, 240 Vac	31637
DS1	558-0102-003	LED (NEX HI)	72619
DS2	Same as DS1	(INPUT LO)	
DS3	Same as DS1	(INPUT HI)	
DS4	Same as DS1	(NEX LO)	
J1	UG1094A/U	Connector, BNC (VIDEO IN)	81349
J3	Same as J1	(NOISE SOURCE)	
J4	Same as J1	(ANALOG OUT)	
M1	5930230G1	Meter, digital, 117 Vac	31637
M1	5930230G2	Meter, digital, 220 Vac	31637
M1	5930230G3	Meter, digital, 100 Vac	31637
M1	5930230G4	Meter, digital, 240 Vac	31637
R1	5930239P1	Potentiometer, 5K	31637
or	MW10-10-5K	10 Turn Potentiometer 5K	19477
S1	MTF-206N	Switch, DPDT	95146
W1	5930232G2	Cable assembly (IF in)	31637

Table 6-3. Circuit Card A1
Electrical Parts List

REF DES	PART NO.	DESCRIPTION	MFR CODE
A1	5930212G1	Circuit card subassembly	31637
A1J2	5930221P1	Connector	31637
C1	CK06BX104K	Capacitor, ceramic, 0.1 UF	81349
C2	Same as C1		
C3	CK05BX682K	Capacitor, ceramic, 6800 pF	81349
C4	Same as C1		
C5	CM05ED180JP3	Capacitor, mica, 18 pF	81349
C6	Same as C1		
C7	CK06BX103K	Capacitor, ceramic, 0.01 UF	81349
C8	CK06BX473K	Capacitor, ceramic, 0.047 UF	81349
C9	CK06BX105K	Capacitor, ceramic, 1 UF	81349
C10	CM05ED510JP3	Capacitor, mica, 51 pF	81349
C11	CC06CG102J	Capacitor, ceramic, 1000 pF	81349
C12	Same as C11		
C13	Same as C8		
C14	Same as C7		
C15	Same as C7		
C16	M39003/01-2271	Capacitor, tantalum, 22 UF	81349

Table 6-3. Circuit Card A1
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
C17	Same as C1		
C18	M39003/01-2268	Capacitor, tantalum, 3.3 UF	81349
C19 through C22	Same as C1		
CR1 through CR6	JAN1N4148	Semiconductor diode	81349
F1	276.500	Fuse, 0.5A	75915
F2	Same as F1		
J1	3428-2002	Connector	75037
Q1	JAN2N2907	Transistor	81349
Q2	JAN2N2222	Transistor	81349
Q3	2N4856	Transistor, FET	01295
Q4	Same as Q3		
Q5	Same as Q2		
Q6	Same as Q3		
Q7	Same as Q3		
Q8	Same as Q3		
Q9	Same as Q1		
R1	RCR07G111JS	Resistor, 110 ohms, 5%, 1/4W	81349

Table 6-3. Circuit Card A1
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
R2	RT24CW501	Resistor, variable, 500 ohms	81349
R3	RWR89S5110FM	Resistor, 511 ohms, 1%, 3W	81349
R4	Same as R2		
R5	Same as R2		
R6	Same as R2		
R7	RCR07G103JS	Resistor, 10K, 5%, 1 4W	81349
R8	RCR07G510JS	Resistor, 51 ohms, 5%, 1 4W	81349
R9	Same as R8		
R10	RCR07G104JS	Resistor, 100K, 5%, 1 4W	81349
R11	RCR07G512JS	Resistor, 5.1K, 5%, 1/4W	81349
R12	RNC55H1102FS	Resistor, 11K, 1%, 1/10W	81349
R13	RNC55H1212FS	Resistor, 12.1K, 1%, 1/10W	81349
R14	Same as R13		
R15	Same as R7		
R16	Same as R7		
R17	RCR07G242JS	Resistor, 2.4K, 5%, 1/4W	81349
R18	RCR07G511JS	Resistor, 510 ohms, 5%, 1/4W	81349
R19	Same as R11		
R20	RCR07G102JS	Resistor, 1K, 5%, 1/4W	81349
R21	Same as R7		
R22	RCR07G472JS	Resistor, 4.7K, 5%, 1 4W	81349

Table 6-3. Circuit Card A1
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
R23	Same as R7		
R24	Same as R7		
R25	RCR07G433JS	Resistor, 43K, 5%, 1/4W	81349
R26	RCR07G823JS	Resistor, 82K, 5%, 1/4W	81349
R27	RCR07G473JS	Resistor, 47K, 5%, 1/4W	81349
R28	Same as R22		
R29	Same as R17		
R30	Not used		
R31	Same as R20		
R32	RCR07G822JS	Resistor, 8.2K, 5%, 1/4W	81349
R33	Same as R27		
R34	Same as R20		
R35	RCR07G302JS	Resistor, 3K, 5%, 1/4W	81349
R36	RCR07G911JS	Resistor, 910 ohms, 5%, 1/4W	81349
R37	Same as R17		
R38	D1608A103C	Resistor network, 10K x 8, 1/4%	56235
R39	RCR07G114JS	Resistor, 110K, 5%, 1/4W	81349
R40	RCR07G224JS	Resistor, 220K, 5%, 1/4W	81349
R41	RCR07G752JS	Resistor, 7.5K, 5%, 1/4W	81349
R42	Same as R41		
R43	Same as R7		

Table 6-3. Circuit Card A1
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
R44	Same as R1		
R45	Same as R22		
R46	Same as R11		
R47	RCR07G153JS	Resistor, 15K, 5%, 1/4W	81349
R48	RCR07G105JS	Resistor, 1 meg, 5%, 1/4W	81349
R49	66XR1M	Resistor, vbl, 1 meg	81349
R50	RNC55H1001FS	Resistor, 1K, 1%, 1/10W	81349
R51	RNC55H5110FS	Resistor, 511 ohms, 1%, 1/10W	81349
R52	RNC55H1000FS	Resistor, 100 ohms, 1%, 1/10W	81349
S1	5930224P1	Switch assembly	31637
TP1	256064P8	Socket, test, brown	94117
TP2	256064P2	Socket, test, red	94117
TP3	256064P6	Socket, test, orange	94117
TP4	256064P7	Socket, test, yellow	94117
TP5	256064P4	Socket, test, green	94117
TP6	256064P10	Socket, test, blue	94117
TP7	256064P12	Socket, test, violet	94117
TP8	256064P13	Socket, test, gray	94117
TP9	256064P1	Socket, test, white	94117
TP10	256064P3	Socket, test, black	94117
U1	LM317H	MED, regulator	27014
U2	MC14017BAL	MED, frequency divider	04713

Table 6-3. Circuit Card A1
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
U3	5930245P1	MED, dual single-shot	31637
U4	5930246P1	MED, quad 2-input NAND gate	31637
U5	Same as U3		
U6	CD4009UBE	MED, hex inverters, open collector outputs	02735
VR1	JAN1N4370A	Diode, zener	81349
VR2	Same as VR1		
VR3	JAN1N747A	Diode, zener	81349
W1	5930223P1	Cable assembly	31637
W1J3	2VH15/1AN5-56	Connector	05574
Z1	LM118H	MED, operational amplifier	27014
Z2	AD582KH	MED, sample and hold	24355
Z3	Same as Z2		
Z4	AD510JH	MED, operational amplifier	24355
Z5	757N	Logarithmic amplifier	24355
Z6	Same as Z4		
Z7	UA741HC	MED, operational amplifier	07263
Z8	HA2-2525-5	MED, operational amplifier	34371
Z9	Same as Z8		
Z10	AD534LH	MED, squarer	24355

Table 6-4. Circuit Card A2
Electrical Parts List

REF DES	PART NO.	DESCRIPTION	MFR CODE
A1	5930217G2	Circuit card subassembly	31637
C1	CK05BX102K	Capacitor, ceramic, 1000 pF	81349
C2	Not used		
C3	Same as C1		
C4	Same as C1		
C5	CK06BX104K	Capacitor, ceramic, 0.1 UF	81349
C6	Same as C1		
C7	Same as C1		
C8	Same as C1		
C9	CV31D350	Capacitor, variable, 9-35 pF	81349
C10	Same as C9		
C11	Same as C1		
C12	CK06BX103K	Capacitor, ceramic, 0.01 UF	81349
C13	Same as C5		
C14	140004P546	Capacitor, met, poly., 5.6 UF, 50V	94117
C15	Same as C5		
C16	Same as C1		
C17	CV31A080	Capacitor, variable, 9-35 pF	81349
C18	Same as C12		

Table 6-4. Circuit Card A2
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
C19	Same as C1		
C20	Same as C1		
C21	CM05FD151JP3	Capacitor, mica, 150 pF	81349
C22	Same as C1		
C23	Same as C12		
C24	Same as C12		
CR1	1N4148	Semiconductor diode	31637
CR2	Same as CR1		
CR3	Not used		
CR4	Not used		
CR5	Not used		
CR6	Not used		
CR7	5958243G1	Diode, Detector	31637
D1	5930247	Diode, varactor	31637
J1	50-051-0000	Connector, coax	98291
K1	922A12C2C	Relay	81349
L1	5930249	Inductor, 10 UH	31637
L2	MS75084-16	Inductor, 22 UH	81349
L3 through L6	Same as L1		
L7	Same as L2		
PS1	4571	Power supply, +15V, dual input	10049

Table 6-4. Circuit Card A2
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
PS2	4561	Power supply, 22V, dual input	10049
PS2	4608	Power supply, 28V, dual option 2	10049
Q1	2N3866	Transistor	02735
Q2	Same as Q1		
R1 through R6	Not used		
R7	RCR07G621JS	Resistor, 620 ohms, 5%, 1/4W	81349
R8	RCR07G202JS	Resistor, 2K, 5%, 1/4W	81349
R9	Same as R8		
R10	RCR07G102JS	Resistor, 1K, 5%, 1/4W	81349
R11	RCR07G510JS	Resistor, 51 ohms, 5%, 1/4W	81349
R12	RCR20G151JS	Resistor, 150 ohms, 5%, 1/2W	81349
R13	RCR07G333JS	Resistor, 33K, 5%, 1/4W	81349
R14	RCR07G104JS	Resistor, 100K, 5%, 1/4W	81349
R15	Same as R14		
R16	RJ24CW203	Resistor, variable, 20K	81349
R17	Same as R11		

Table 6-4. Circuit Card A2
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
R18	RCR07G472JS	Resistor, 4.7K, 5%, 1/4W	81349
R19	RCR07G222JS	Resistor, 2.2K, 5%, 1/4W	81349
R20	Same as R10		
R21	Same as R18		
R22	RCR20G121JS	Resistor, 120 ohms, 5%, 1/2W	81349
R23	RCR07G754JS	Resistor, 750K, 5%, 1/4W	81349
R24	RCR07G912JS	Resistor, 9.1K, 5%, 1/4W	81349
R25 through R33	Not used		
R34	RNC55H1782FS	Resistor, 17.8K, 1%, 1/8W	81349
R35	Same as R34		
R36	RNC55H7500FS	Resistor, 750 ohms, 1%, 1/8W	81349
R37	RNC55H1001FS	Resistor, 1K, 1%, 1/8W	81349
R38	Same as R16		
R39	Same as R16		
R40 through R43	RCR07G681JS	Resistor, 680 ohms, 5%, 1/4W	81349
R44	RCR07G101JS	Resistor, 100 ohms, 5%, 1/4W	81349

Table 6-4. Circuit Card A2
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
R45	Not used		
R46	RCR05G822JS	Resistor, 8.2K, 5%, 1/8W	81349
R47	RCR05G822JS	Resistor, 8.2K, 5%, 1/8W	81349
R48	RCR07G221JS	Resistor, 220 ohms, 5%, 1/4W	81349
T1	5930235P1	Transformer	31637
T2	5930235P2	Transformer	31637
T3	5930235P3	Transformer	31637
TP1	256064P8	Socket, test, brown	94117
TP2	256064P2	Socket, test, red	94117
TP3	256064P6	Socket, test, orange	94117
TP4	256064P7	Socket, test, yellow	94117
TP5	256064P4	Socket, test, green	94117
TP6	256064P10	Socket, test, blue	94117
TP7	256064P12	Socket, test, violet	94117
U1	Not used		
U2	SN54LS00J	MED, quad 2-input NAND gate	01295
U3	TL084BCN	MED, dual op amp	01295
U4	LM139D	MED, quad voltage comparator	27014

Table 6-4. Circuit Card A2
Electrical Parts List (Cont)

REF DES	PART NO.	DESCRIPTION	MFR CODE
W1	1044030P1	Cable, flat	94117
Z1	MC1590G	MED, IF amplifier	04713
Z2	MD-108	Mixer, RF	11556
Z3	GPD-401	Amplifier Option 1	24539
	GPD-201	Amplifier Option 11	24539

Table 6-5. Index of Manufacturers

MFR CODE	MANUFACTURER'S NAME AND ADDRESS
01295	Texas Instruments, Inc. Components Group P.O. Box 5012 13500 N. Central Expressway Dallas, Texas 75222
02735	RCA Corporation RCA Solid State Division Rt. 202 Somerville, New Jersey 08876
04713	Motorola Inc. Semiconductor Products Div. 5005 East McDowell Road Phoenix, Arizona 85008
05574	Viking Industries Inc. Datacon Division 21001 Nordhoff Street Chatsworth, California 91311
07263	Fairchild Semiconductor 464 Ellis Street Mountain View, California 94042

Table 6-5. Index of Manufacturers (Cont)

MFR CODE	MANUFACTURER'S NAME AND ADDRESS
10049	Teco Corp. Bay Road P.O. Box 218 Winnesquam, New Hampshire 03289
11556	Adams-Russell Co. Inc. Antenna and Microwave Div. Haverhill Road Amesbury, Massachusetts 01913
16179	Omni Spectra, Inc. 21 Continental Blvd. Merrimack, New Hampshire 03054
17540	Alpha Industries, Inc. 20 Sylvan Road Woburn, Massachusetts 01801
19447	ETI 215 Via Del Norte Oceanside, California 92054
24355	Analog Devices, Inc. P.O. Box 280 Route 1 Industrial Park Norwood, Massachusetts 02062

Table 6-5. Index of Manufacturers (Cont)

MFR CODE	MANUFACTURER'S NAME AND ADDRESS
24539	Avantek Inc. 3175 Bowers Avenue Santa Clara, California 95051
27014	National Semiconductor Corp. 2900 San Ysidro Way Santa Clara, California 95051
31637	Sanders Associates, Inc. Microwave Division Grenier Field Manchester, New Hampshire 03103
34371	Harris Semiconductor Division Harris Corporation P.O. Box 883 Melbourne, Florida 32901
56235	State of the Art Inc. 445 Railroad Ave. State College, Pennsylvania 16801
72619	Dialight Division Amperex Electronic Corp. 203 Harrison Place Brooklyn, New York 11237

Table 6-5. Index of Manufacturers (Cont)

MFR CODE	MANUFACTURER'S NAME AND ADDRESS
75037	3M Company, Electronic Products Div. 3M Center St. Paul, Minnesota 55101
75915	Littlefuse, Inc. 800 E. Northwest Highway Des Plaines, Illinois 60016
81349	Military Specifications Promulgated by Military Departments/ Agencies under authority of Defense Standardization Manual Washington, DC 41203
82389	Switchcraft, Inc. Subsidiary of Raytheon Co. 5555 N. Elston Ave. Chicago, Illinois 60630

Table 6-5. Index of Manufacturers (Cont)

MFR CODE	MANUFACTURER'S NAME AND ADDRESS
94117	Sanders Associates, Inc. 95 Canal Street Nashua, New Hampshire 03061
95146	ALCO Electronic Products P.O. Box 1348 Lawrence, Massachusetts 01843
98291	Sealectro Corp. 225 Hoyt Street Mamaroneck, New York 10544

APPENDIX A

SPECIAL INSTRUCTIONS FOR AN/WLR-1 MEASUREMENTS

A.1 PURPOSE

Anomalies prevalent in AN/WLR-1 systems require that the user take certain precautions to achieve optimum noise figure measurements. While these anomalies may or may not exist in all samples, experience with several systems has resulted in the following recommendations.

1. All measurements should be made at IF. Measurements at the VIDEO output are not recommended due to the non-linearity of the WLR-1 detector.

2. IF outputs to be used are as follows:

a. For bands 1, 2, and 3, disconnect cable from J5 (FM OUT) on CV/741. Connect a BNC cable from J5 to test set IF IN connector with a 20-dB attenuator in the line.

b. For bands 4 through 10, disconnect cable from J4 (FM OUT) CV/742. Connect a BNC cable from J4 to test set IF IN connector with a 20-dB attenuator in the line.

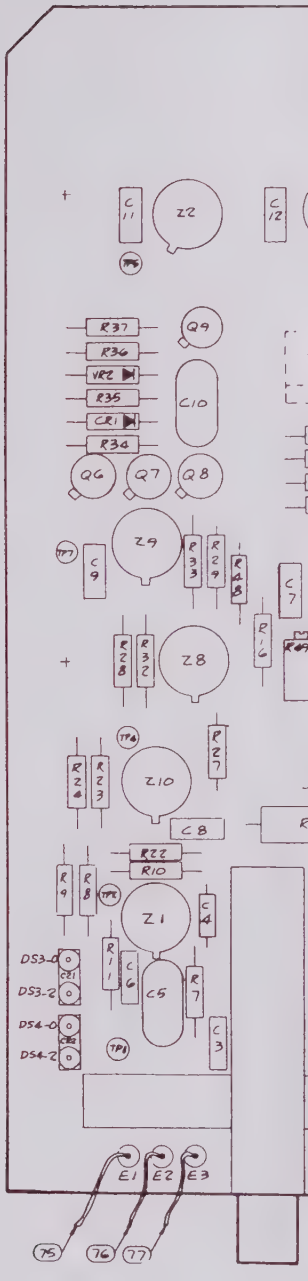
3. Follow procedure in section 4, paragraph 4.2, IF NOISE FIGURE MEASUREMENT.

4. The setting of the GAIN control on the WLR-1 is important. Some systems have been found to saturate at relatively low GAIN settings, resulting in erroneous readings. The ideal setting is between -30 and -40 dBm of system noise power at the test set IF input. With the 20 dB attenuator between the CV/741 or CV/742 and the test set, this represents between -10 and -20 dBm at the CV/74X output. This gain setting will result in a very slight "Noise" indication on the panoramic display and in some cases, no indication at all. Since no two systems are exactly alike, the ideal procedure would be to use a power meter to set the GAIN. After an initial measurement on a particular system, the user should become accustomed to the WLR-1.

5. If comparative manual Y-factor measurements are to be made using a power meter, a filter must be inserted between the WLR-1 IF output and the power meter. The reason is that the WLR-1 IF outputs contain several spurious responses that are measured by the broadband power meter. The spurious responses tend to contaminate the power readings and result in erroneous results.

Noise figure measuring instruments actually measure spot noise figure and typically see only about a 1 MHz wide portion of the IF passband. All other responses are filtered out. This is typical of all instruments available in the marketplace, including the Sanders Model 5440C Noise Figure Test Set.

Note that filters are not required when using the Model 5440C. They are only required for normal Y-factor measurements.


Z2
C11
C12
R37
R36
VR2
R35
CR1
R34
Q9
C10
Q6
Q7
Q8
Z9
TP7
C9
R33
R29
R28
C7
R6
R28
R32
Z8
TP6
R24
R23
Z10
R27
C8
R22
R10
R9
R8
TP5
Z1
C4
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DS3-2
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E3
TP5
TP6
TP7

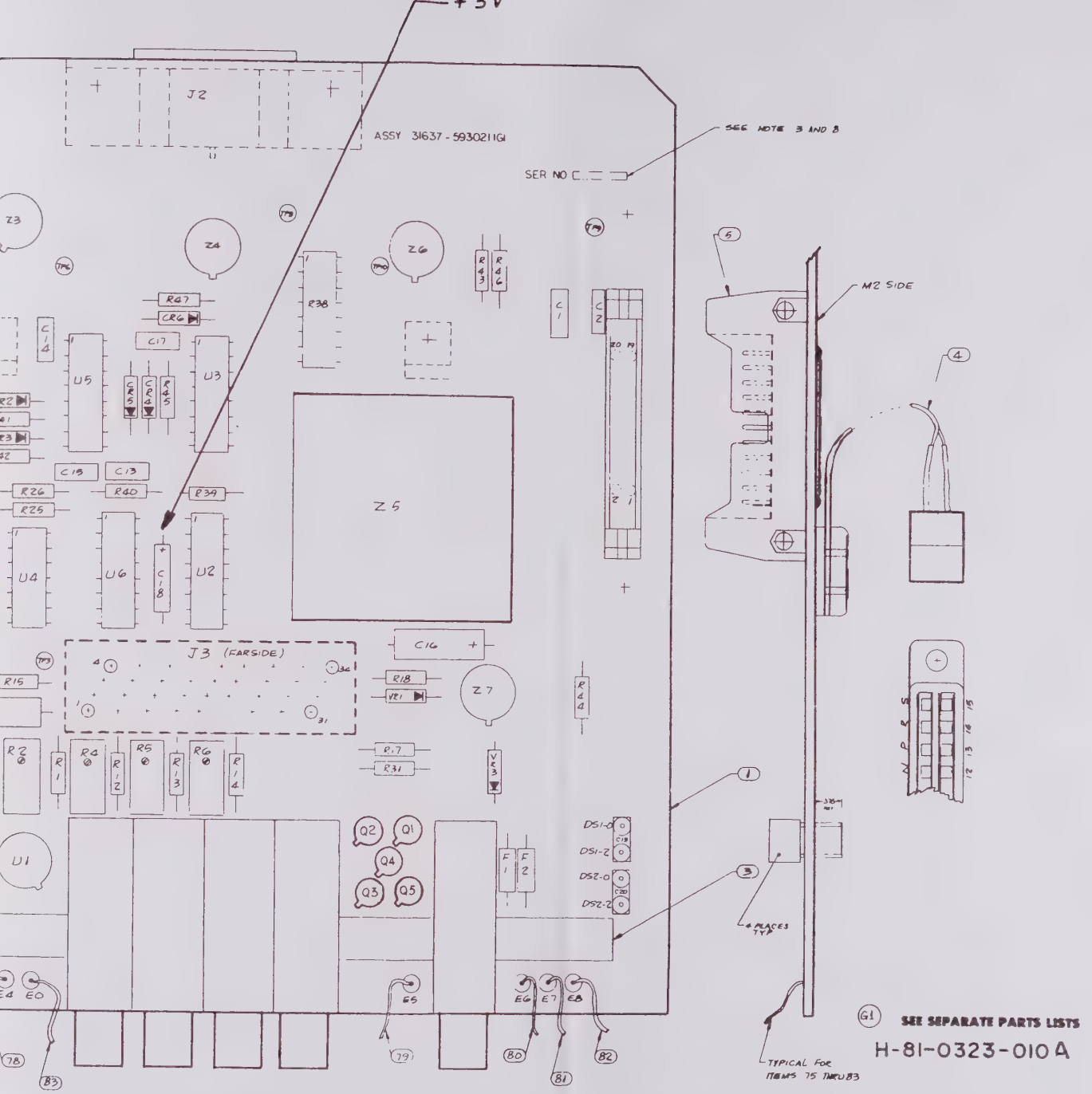
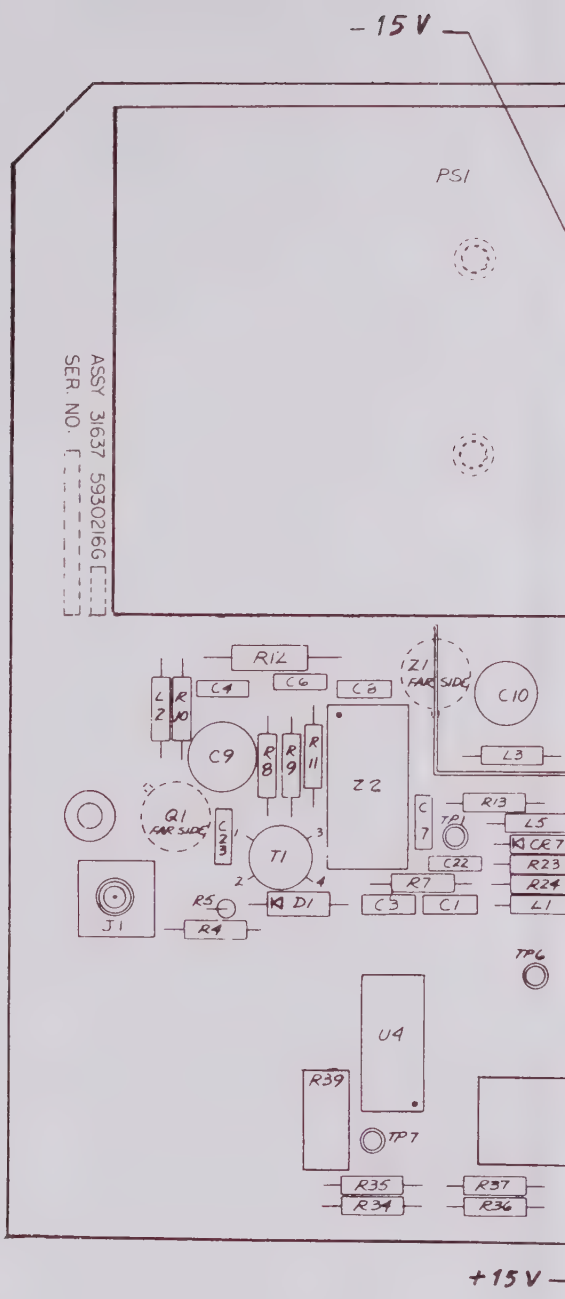


Figure FO-1. Parts Location, Circuit Card No. A1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PS1
ASSY 31637 5930216G
SER NO.
R12
C4
C6
C8
Z1
FAR SIDE
C10
L2
R10
C9
R8
R9
R11
Z2
L3
R13
L5
CR7
R23
R24
L1
C7
TP1
C22
R7
C3
C1
Q1
FAR SIDE
C11
T1
D1
R5
R4
J1
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R34
R37
R36
+15 V

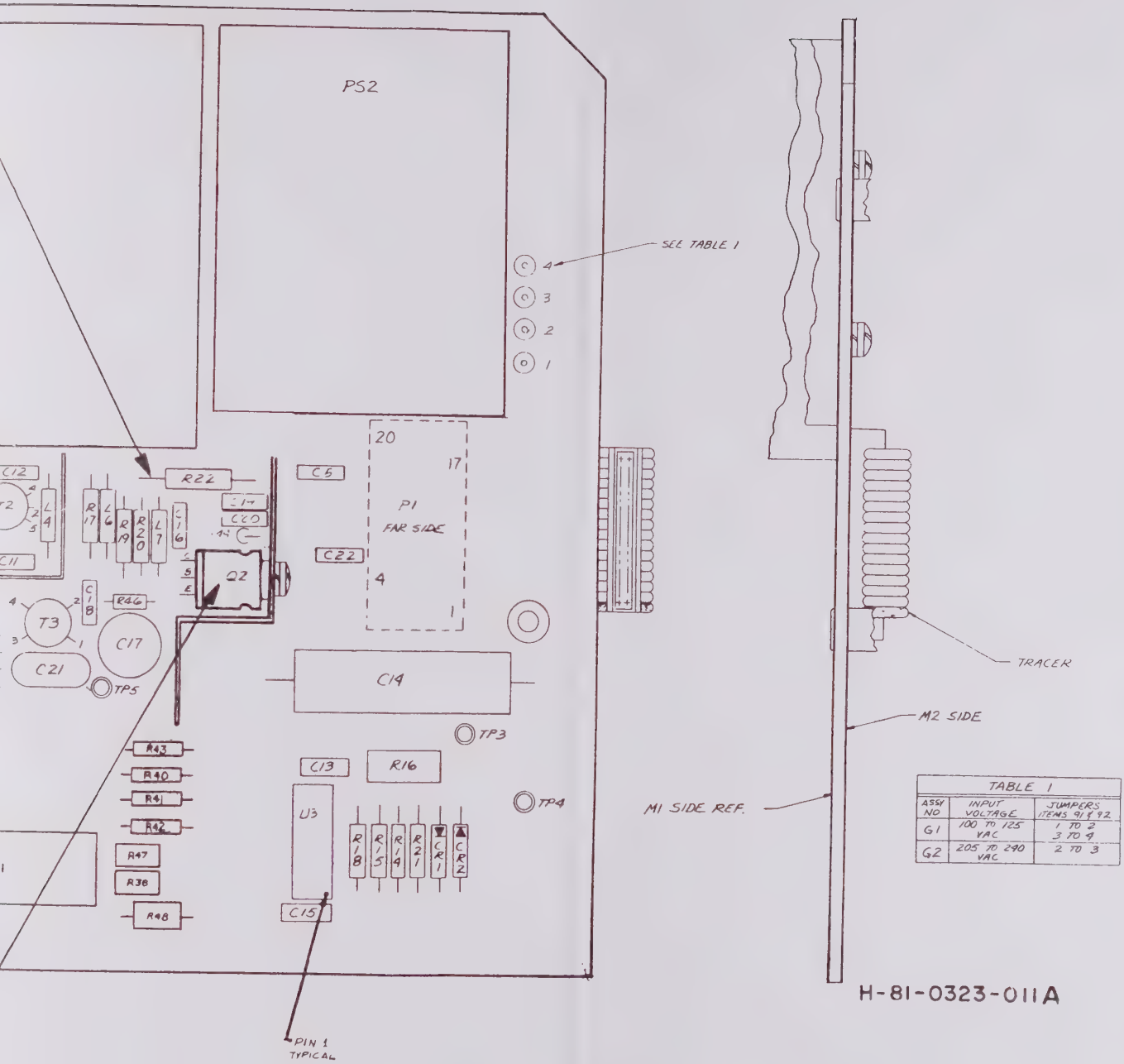


Figure FO-2. Parts Location, Circuit Card No. A2

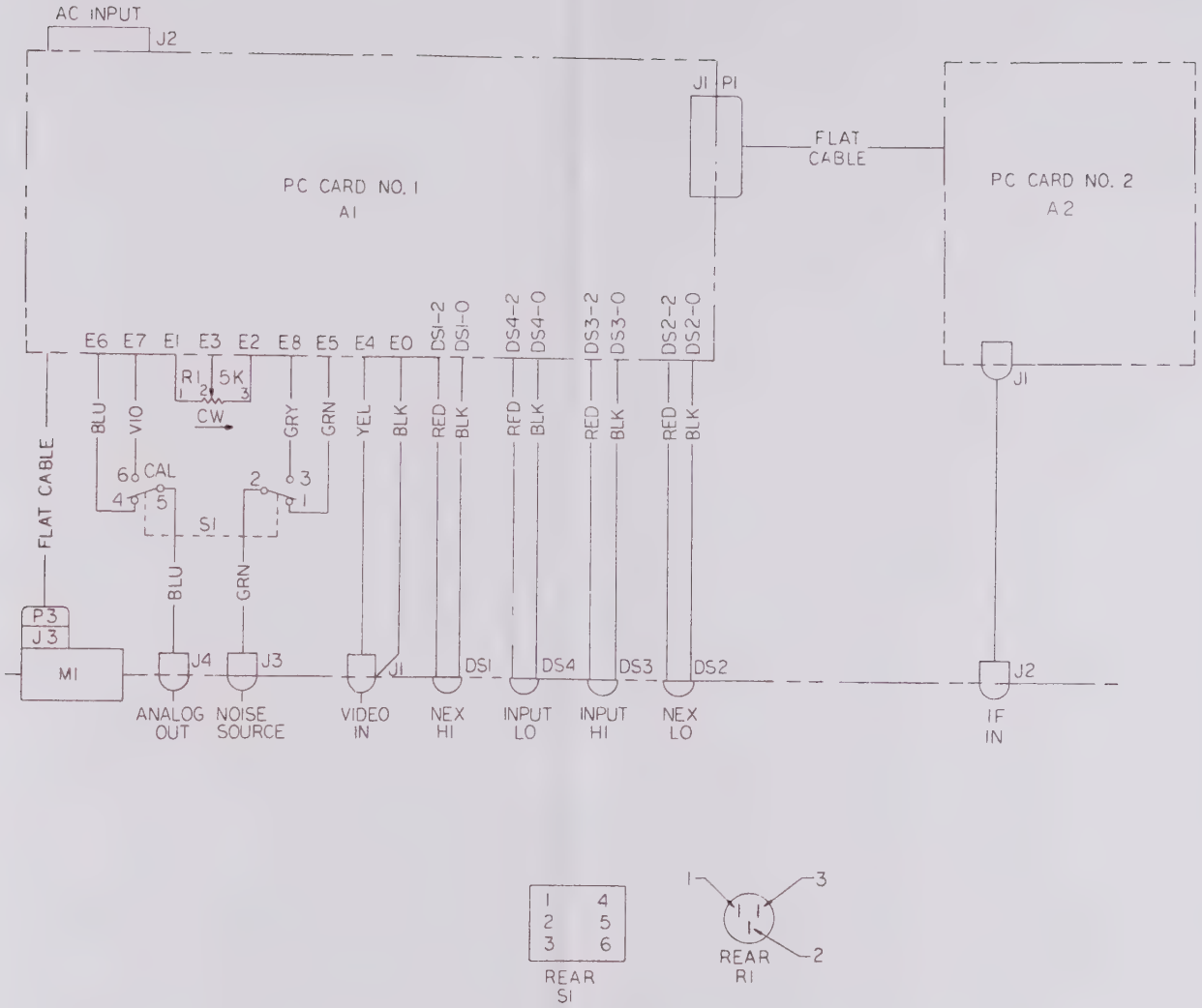
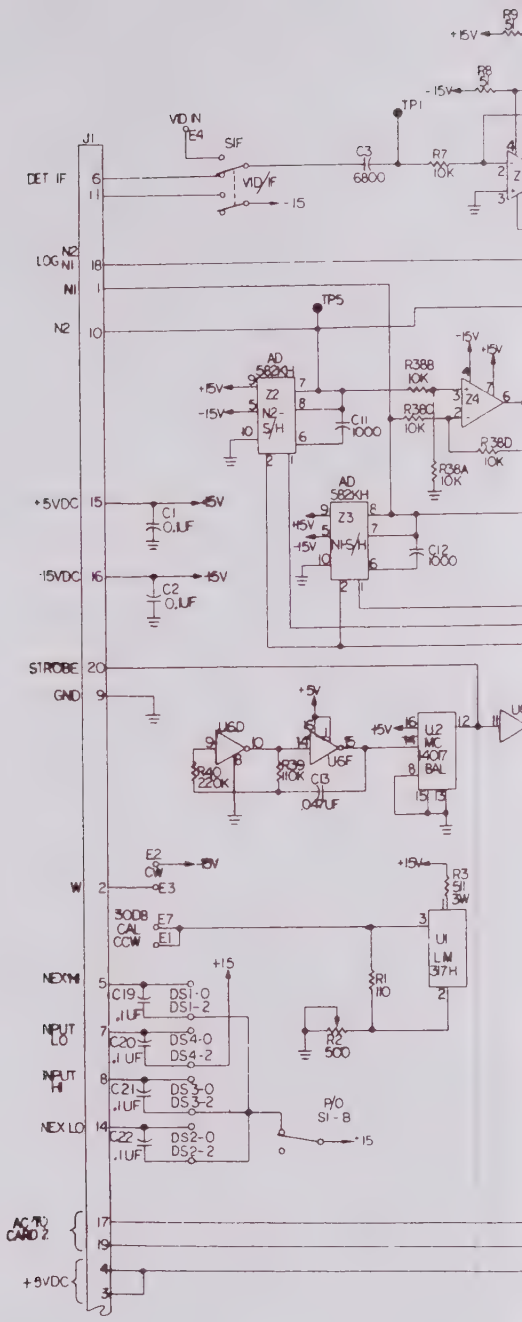


Figure FO-3. Interconnection Diagram


+15V
-15V
TP1
VID IN
E4
SIF
J1
DET IF
6
11
VID/IF
-15
C3
6800
R7
10K
LOG N2
N1
18
1
N2
10
TP5
AD
582KH
Z2
N2-
S/H
+15V
-15V
C11
1000
R38B
10K
R38C
10K
R38A
10K
R38D
10K
Z4
+5VDC
15
C1
0.1UF
-15VDC
16
C2
0.1UF
Z3
N1-S/H
C12
1000
STROBE
20
GND
9
+5V
U6D
U6F
R39A
220K
R39B
110K
C13
.047UF
U2
MC
1407
BAL
E2
CW
E3
W
2
300B
CAL
CCW
E7
E1
R3
5K
3W
U1
LM
317H
R1
110
R2
500
NEX HI
5
INPUT
LO
7
INPUT
HI
8
NEX LO
14
C19
.1UF
C20
.1 UF
C21
.1UF
C22
.1UF
DS1-0
DS1-2
DS4-0
DS4-2
DS3-0
DS3-2
DS2-0
DS2-2
P/O
S1-B
+15
ACTU
CARD 2
17
19
+5VDC
4
3

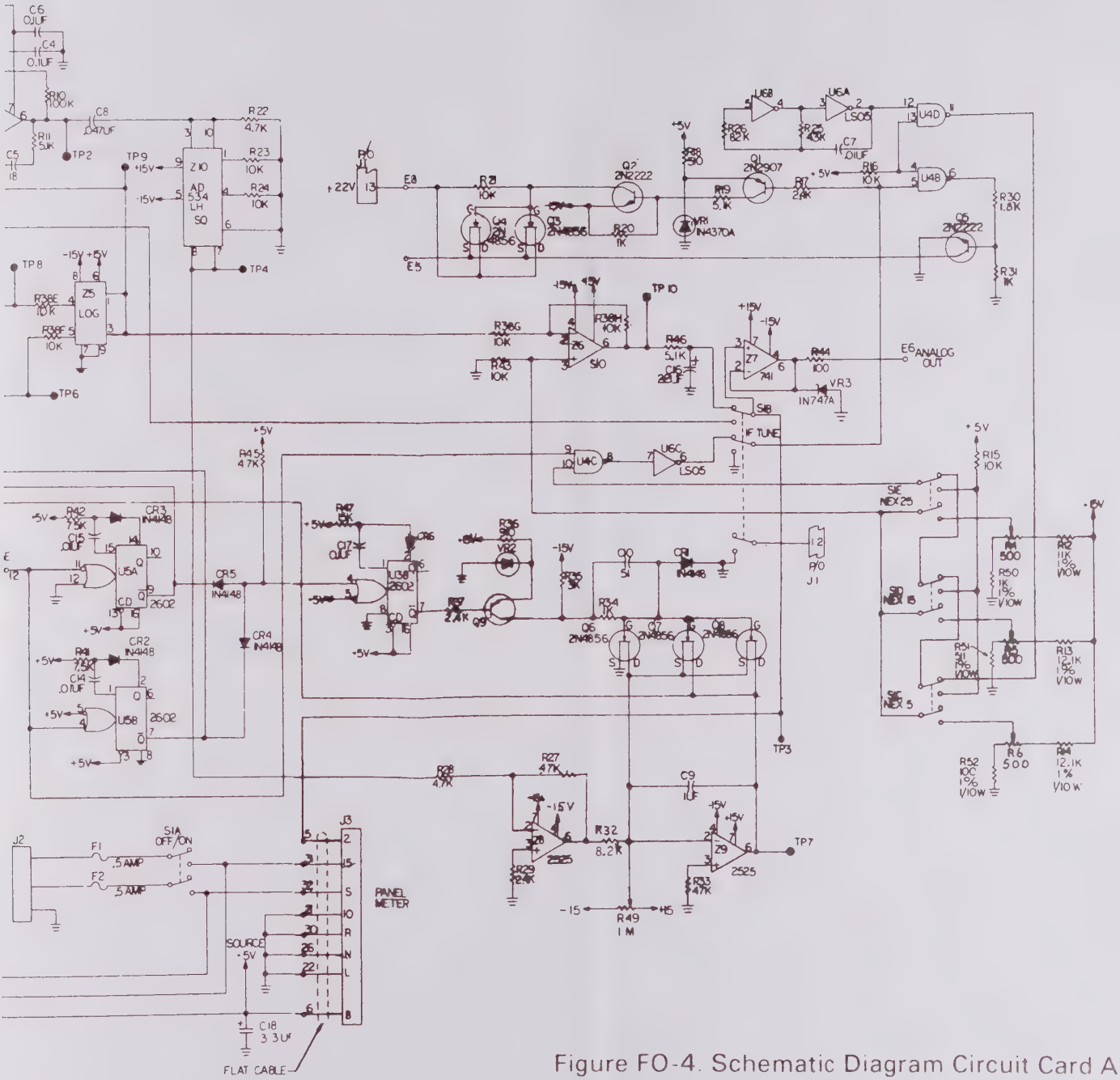
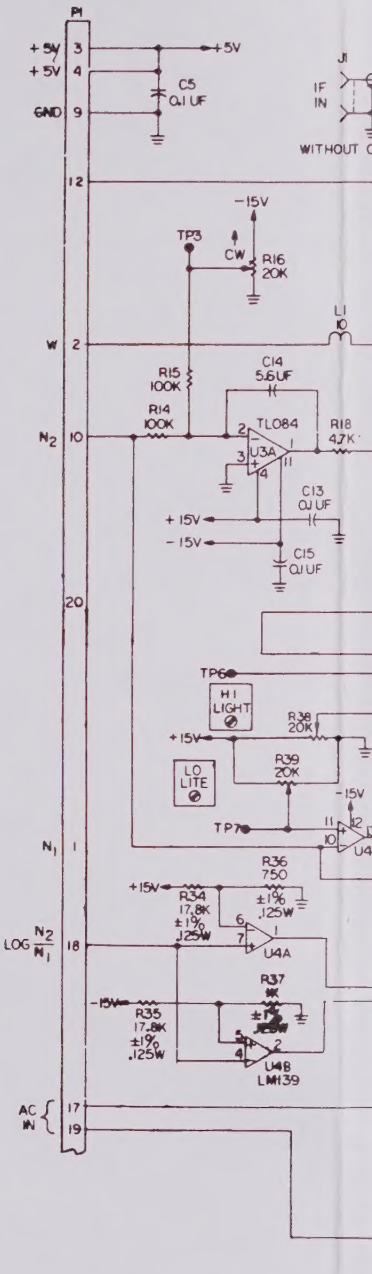


Figure FO-4. Schematic Diagram Circuit Card A1


P1
+5V
+5V
GND
C5
0.1 UF
J1
IF
IN
WITHOUT
-15V
TP3
CW
R16
20K
L1
10
W
2
R15
100K
C14
5.6UF
R14
100K
N2
10
TL084
U3A
R18
4.7K
C13
0.1 UF
+15V
-15V
C15
0.1 UF
20
TP6
HI
LIGHT
R38
20K
+15V
R39
20K
LO
LITE
-15V
TP7
N1
1
R36
750
±1%
.125W
+15V
R34
17.8K
±1%
.125W
LOG N2/N1
18
U4A
R37
-15V
R35
17.8K
±1%
.125W
U4B
LM139
AC
IN
17
19

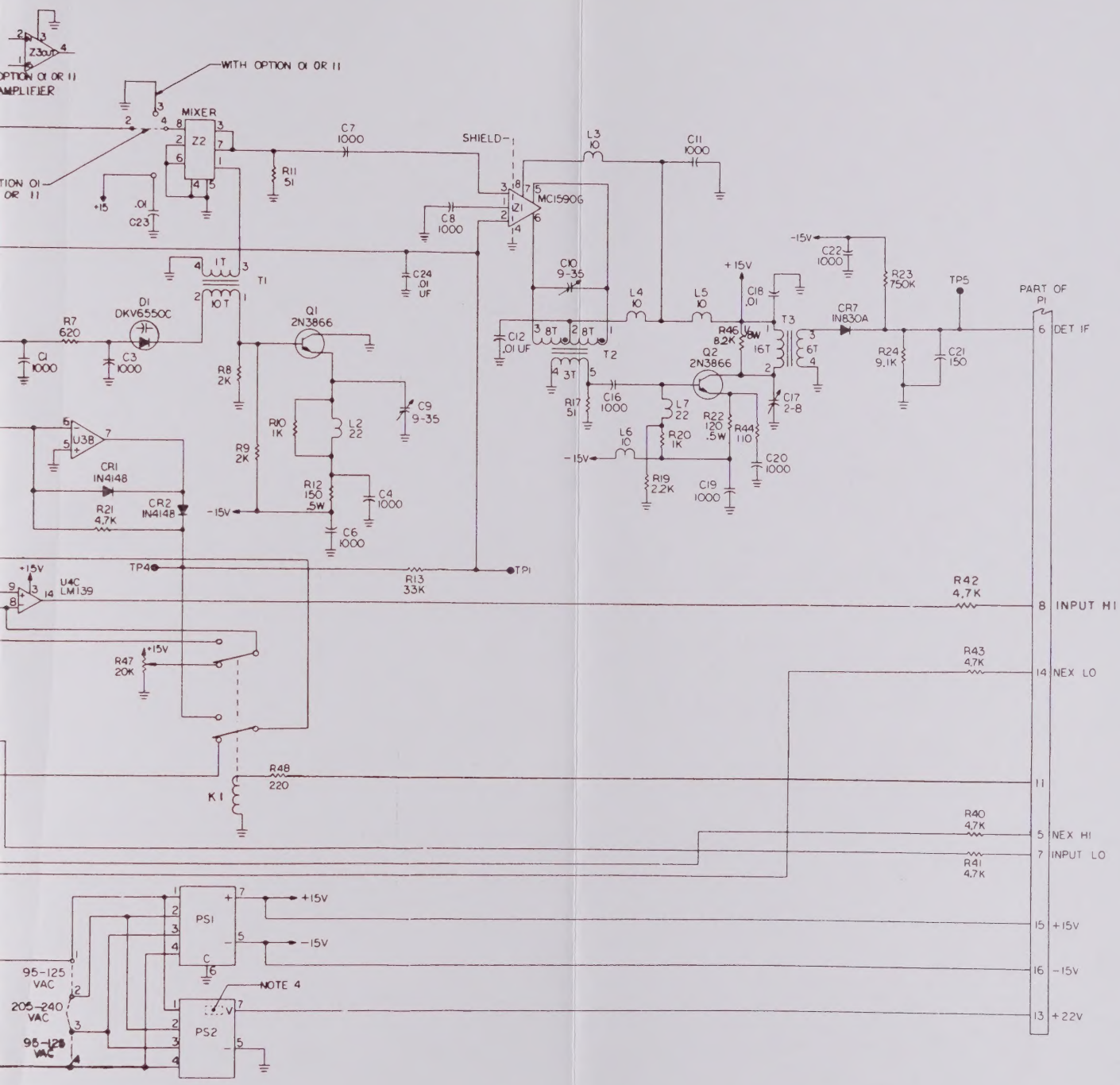


Figure FO-5. Schematic Diagram Circuit Card A2